MAY -2 1938

May 1938

First Copy

TECHNOLOGY REVIEW

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THE TECHNOLOGY REVIEW, May, 1938. Vol. XL, No. 7. Published monthly from November to July inclusive at 10 Ferry Street, Concord, N. H. Publication date: twenty-seventh of the month preceding date of issue. Annual subscription $3.50; Canadian and Foreign subscription $4.00. Entered as second-class matter at the Post Office at Concord, N. H., under the Act of March 3, 1879.

THE TABULAR VIEW

EACH year a committee of the American Alumni Council, a body made up of alumni officers of American colleges, appraises magazines that are published by these colleges. The Review has been encouraged many times by awards received from this group, and this year it again was listed among those magazines judged to have done well some type of journalistic job. The citation read: "The American Alumni Council awards first place to The Technology Review for the best use of type, heads, and captions in the magazine awards contest." ¶ It is worthy of note that the magazines published at scientific and engineering institutions rank high among graduate magazines. The journals published by Case and Lehigh, for example, are executed with great professional competence. While many liberal arts colleges publish first-rate magazines, it is nevertheless striking that the technical magazines have progressed so far in appearance and contents — and in advertising volume.

A STUDENT of mountain climbing and possessor of an extensive collection of literature on the subject, JOHN E. BURCHARD, '23 (page 307), writes with enthusiasm and understanding of the techniques and motives of mountain climbing. During those interludes when he is not practicing his profession as a housing engineer or carrying on such avocational work as the Technology Alumni Fund and Alumni Day, he gets in some climbing of his own. ¶ DR. HARRY R. DESILVA (page 309) is a member of the staff of the Street Traffic Research Bureau at Harvard University and has been associated with the development of the apparatus and methods he describes for testing driving competence. ¶ FREDERICK G. FASSETT, JR., as recorded on page 320, has just been elevated to the position of associate professor of English at the Institute. His understanding of the social significance of science is steadily deepening, as he continues the various papers he has written for The Review on this subject (page 312). Readers will doubtless recall his article, "Science and the State," which appeared in the April, 1937, Review, and also the article, "Science and American Literature" (February, 1937), of which Professor Fassett was coauthor. ¶ GEORGE R. HARRISON is director of applied physics and of the research laboratory of experimental physics at M.I.T. His article on the place of physics in modern life (page 315) is drawn from a book now being written by him on the practical applications of physics. In our first issue this fall (that dated November), we were privileged to present another chapter from this book, "Tomorrow's Telephones." Contributions from Professor Harrison in former years have included the articles, "Molecular Planning" (March, 1936) and "Hard-Headed Rainbow Chasers" (December, 1933). The Lowell Lectures this year in Boston, one of the most distinguished lecture series in America, included a group of lectures by Professor Harrison on the application of physics in modern life.

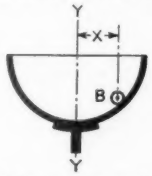
No. 7

Just for Fun!

A CHALLENGE

TO YOUR INGENUITY

HERE is a curiosity from the field of speed indication. — A hemispherical bowl with a radius of 1 foot 1 inch is mounted on a central vertical shaft YY. A one-pound ball B with a radius of 1 inch is free to roll inside the bowl.



On what part of the bowl's surface will the ball tend to ride (i.e., what will be the value of x) if the bowl is spun at 50 R.P.M. about the YY axis? How do you explain this peculiar result? Show that x will increase to about 7 inches at a speed of 60 R.P.M.

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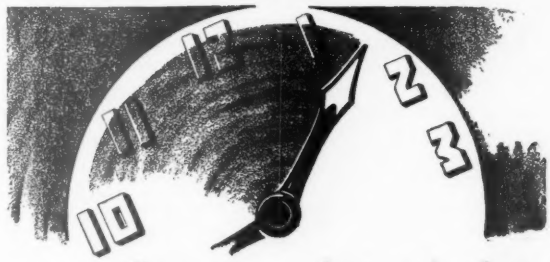

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MAIL RETURNS

LETTERS AND PICTURES FROM REVIEW READERS

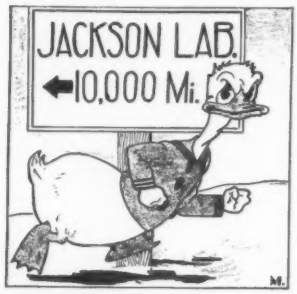
The Duck That Got Wet

FROM C. R. CARYL:

We were interested to note from the March 14 issue of *Time* that the "M.I.T. Review" of that month had carried a story about a duck that could not swim in water to which a wetting agent had been added. Since I am the "chemist" who made the duck sink (but did not roast him afterwards), you can understand my interest in obtaining a copy of your Review. . . .

American Cyanamid and Chemical Corporation
Pittsburgh, Pa.

The experiment described by The Review was performed in the Jackson Laboratory of the Du Pont Company and informally reported on November 17 in a local publication, under the heading "The Dye-Jest." We do not know whether Mr. Caryl's experiment was prior to this, but we do have it on good authority that the Du Pont duck (whose subconscious portrait is reproduced adjacently) was eventually roasted, as The Review reported.



Said the Dye-Jester: "It seems that one member of the family *Anas Boschas* ran afoul of a group of prominent chemists and, for experimental purposes, was placed in a barrel of water to which had been added one of our wetting-out agents. For a moment or two, the duck was in his glory, then he noticed a strange phenomenon — His feathers, usually water-repellent because of the film of oil which covers them, were becoming saturated! In a minute and a half he was as soggy as a dunked doughnut and the look of surprise on his face was akin to a Walt Disney caricature. Giving vent to a quack of alarm, the duck found himself forced to paddle vigorously to keep afloat. In eleven minutes he sank, only to be rescued and freed. With an angry wiggle of his tail feathers he ambled away from his inquisitors."

Stairways in Syria

FROM EDWARD A. ABDUN-NUR, '24:

I was interested in the caption of your picture of the cantilever stairway on page 263 of the April issue of The Review. Practically all stairways in Syria are of this type. Of course labor is cheap there. I have built many of them there — even circular ones cantilevered either from an outside stairwell wall or from a central pipe support. Over in that country they are made usually either of reinforced concrete with a terrazo covering or from slabs of limestone. I am sorry that when I was building them I did not feel it of enough interest (because they were so common) to take any pictures.

Billings, Mont.

Bored to Great Depths

FROM JOHN SLOAT, '33:

Last year, as consulting geophysicist for Union Oil Company of California, it was my good fortune to map by modern geophysical methods what has since become the deepest producing oil field in the world, at Rio Bravo, Calif. At present there are ten of the world's most expensive (that's California for you) oil derricks exploring this superdeep structure. The oil is of high gravity — such that the original well, costing $260,000, paid for itself in a few months after completion. This is a clear-cut case of the success of modern geophysics.

I notice that someone is asking for an article on geophysics. Just wondered if you would be interested in the story of this discovery for The Review. I could furnish pictures, graphs, explanations of methods — your readers would be bored to great depths. . . .

Bakersfield, Calif.

Cover Club Communication

FROM GEORGE A. MAKAROFF, '26:

Many thanks for the extra copies and words of encouragement. Will try to make the cover again, as soon as I manage to print a few "successes" on 8 x 10 glossy. However, my photographic ego is getting the better of me, and I just can't resist mailing you my own favorite — "Night Under the Viaduct." (Note: Naturally it's the sun. Also, for some esthetic reason, I have reversed the negative. . . .)

New York, N. Y.

From Alaska

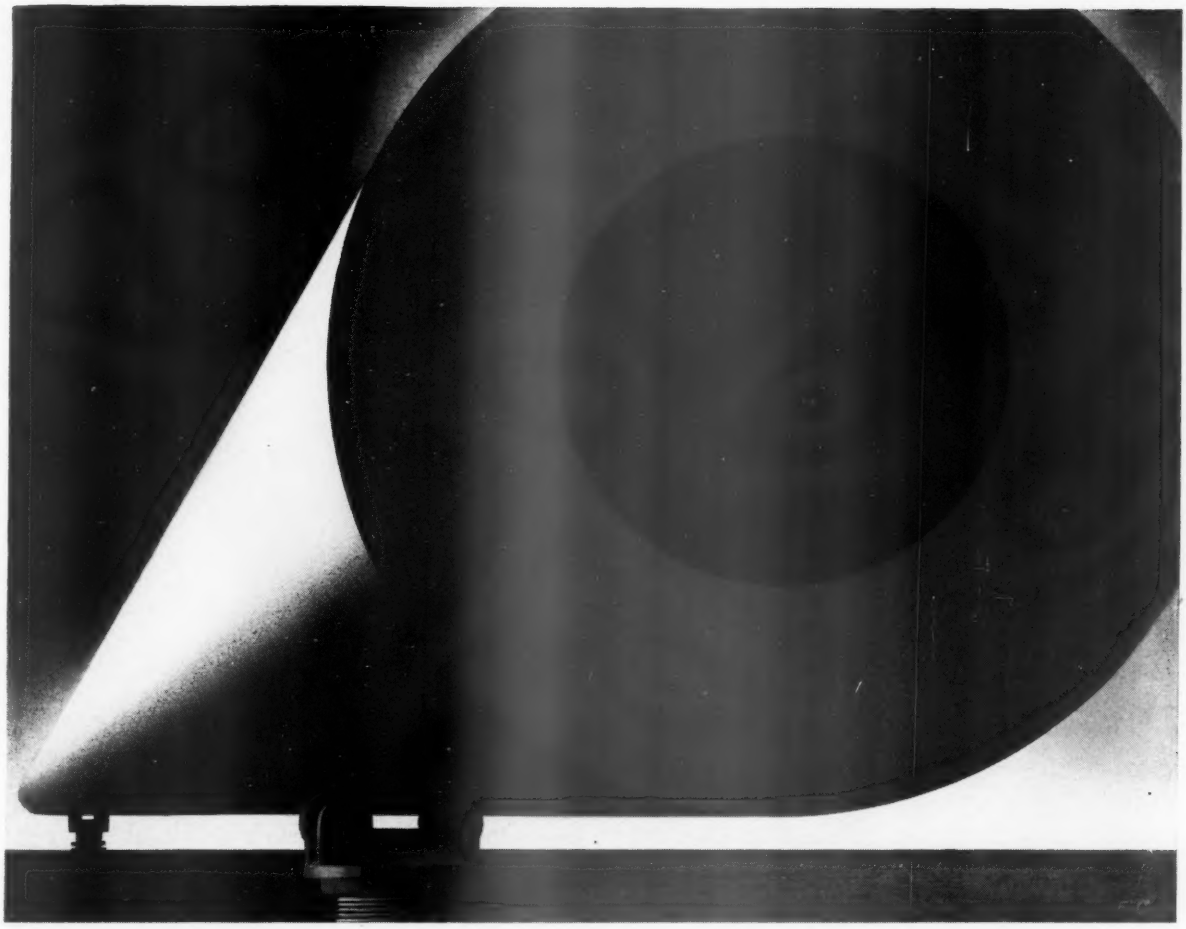
FROM RAY J. BARBER, '06:

President Charles E. Bunnell, pinning the Congressional Medal on Dr. Bramhall, '27, while Dean Barber, '06 **(right),** ***watches***

Ervin Hicks Bramhall, S.B., S.M., Ph.D., '27, VI, has just received a Congressional Medal for distinguished service [for his part in the exploration of the Antarctic with Rear Admiral Byrd in 1933 and 1934]. The medal was awarded by act of Congress some months ago, but the presentation was made . . . at the University of Alaska, where Bramhall is professor of physics and head of the department of general science.

University of Alaska

MAY -2 1938



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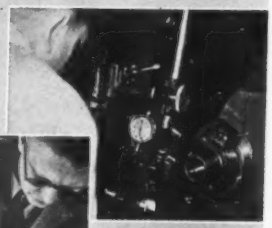

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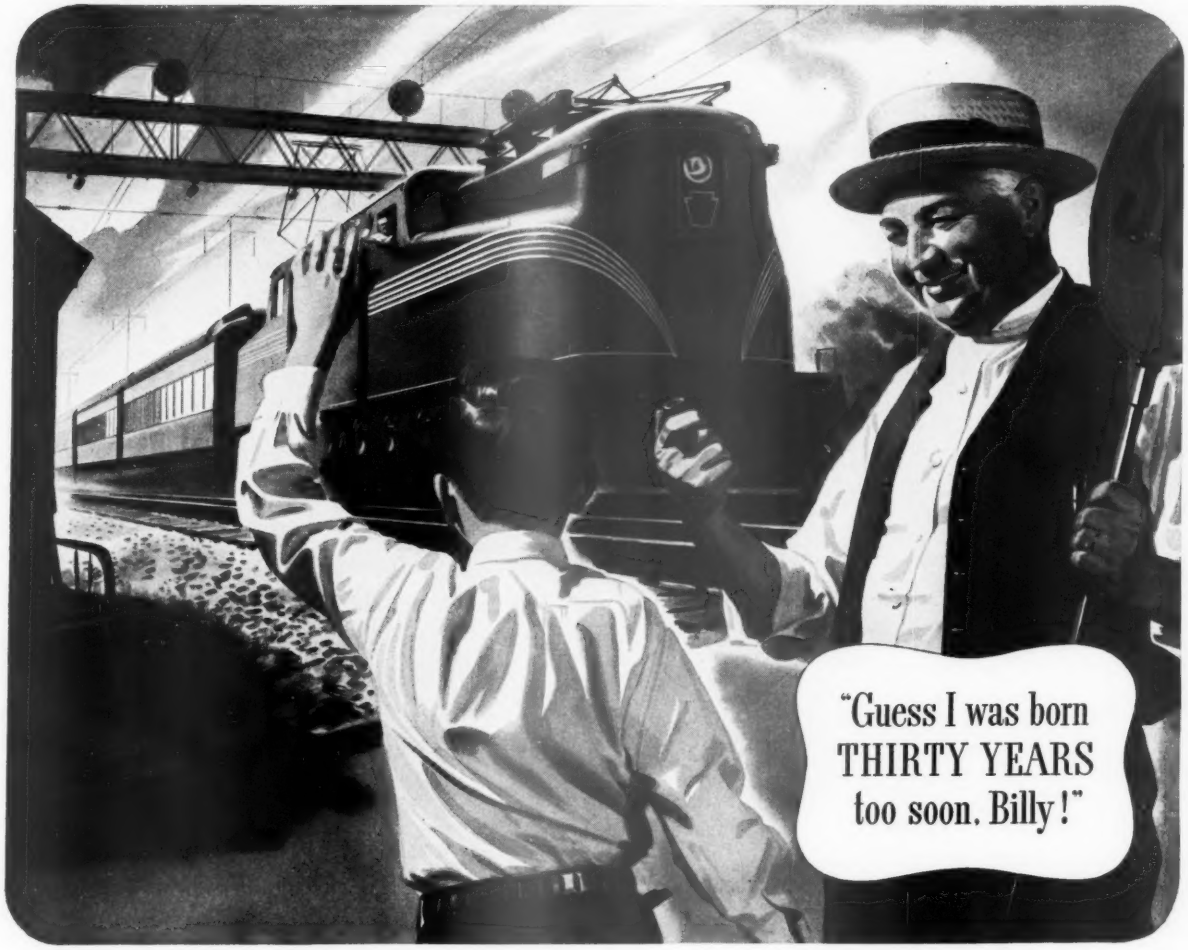

Doing things electrically turns toilers into operators

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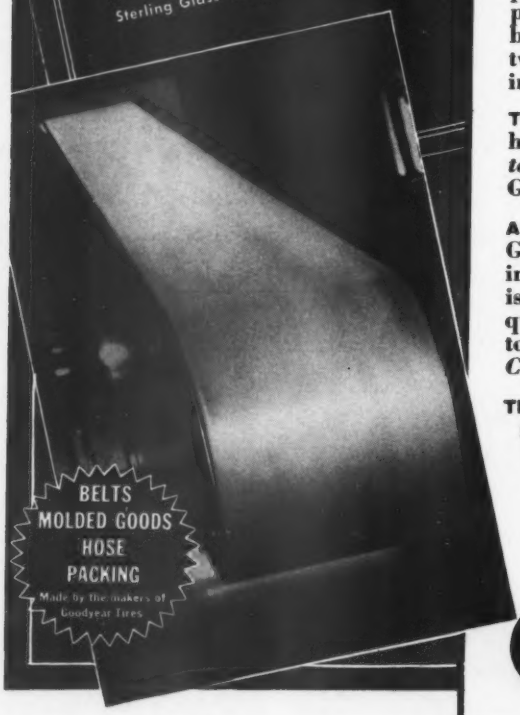

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GOODYEAR

MAY -2 1938

Philip D. Gendreau

THE TECHNOLOGY REVIEW

Title Reg. U. S. Pat. Office

EDITED AT THE MASSACHUSETTS INSTITUTE OF TECHNOLOGY

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From a photograph by James N. Doolittle

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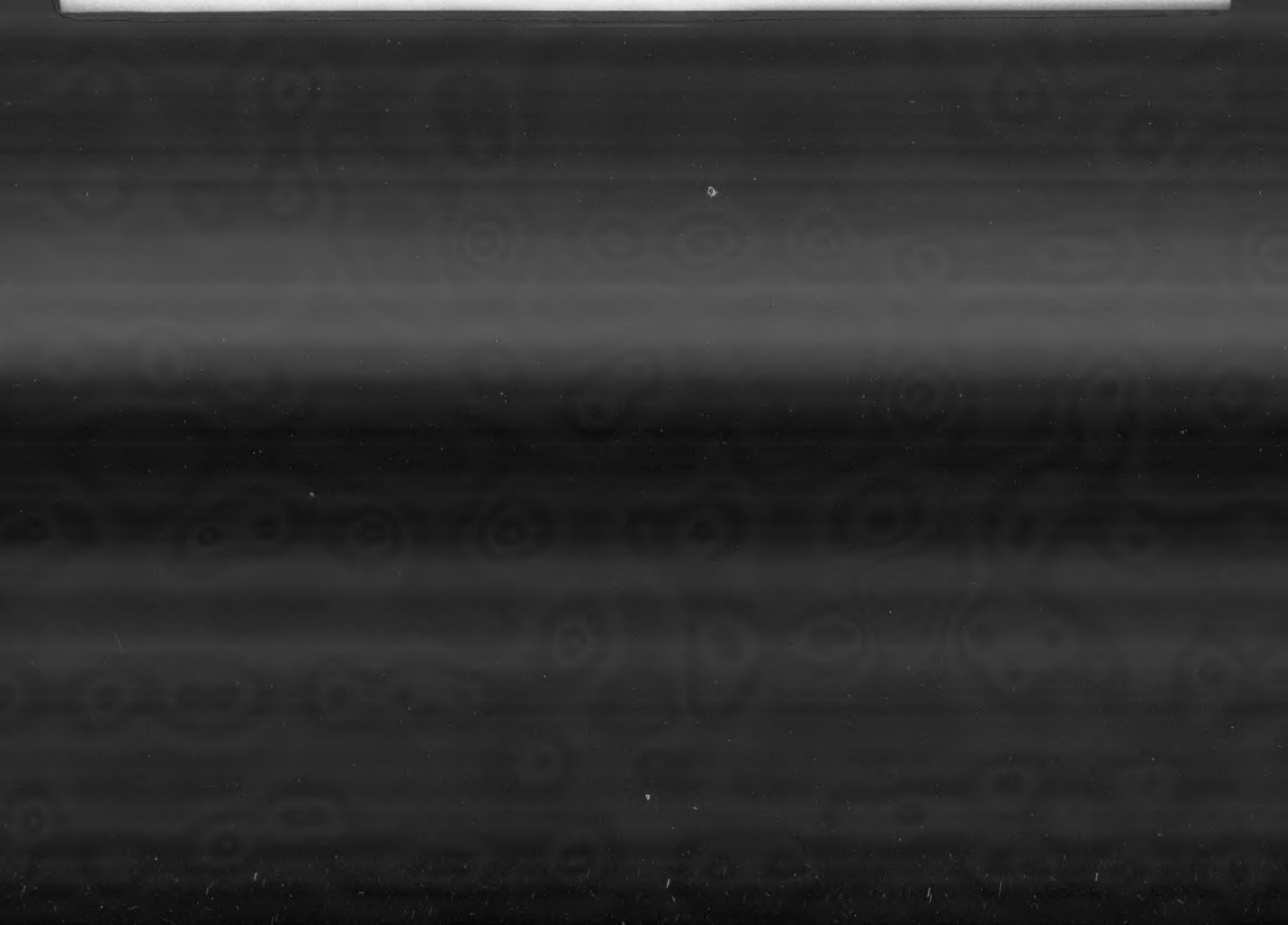


THE
TECHNOLOGY
REVIEW

Vol. 40, No. 7 May, 1938

The Trend of Affairs

Sidelights on the Perennial Miracle

AT the time of the present writing, skunkcabbages are already in bloom in the swamps. Forsythias in the neighborhood of Boston have begun to show yellow in their buds. New maple sugar from Vermont, this season's crop, is on sale in the Boston market. The sugar has come from hard maple or rock maple trees which, at the time when they were tapped, had not yet bloomed or even shown any noticeable swelling of the buds. This new sugar is last year's sugar, photosynthesized from water and carbon dioxide by the energy of last summer's sunshine made effective for the purpose by the catalytic action of the green chlorophyll of last summer's leaves. When the cool weather of autumn came on, the sap retreated to the roots of the trees and there it left its sugar. Now, when the sap flows again, the tree is without leaves and is unequipped to carry on the processes of photosynthesis. But last year's sugar supplies the tree with material which it uses in the manufacture of new leaves with which it will again soon embark upon the business. A wise provision of nature endows the trees, like the squirrels and other creatures of the forest, with an instinct which impels them in the autumn to lay away the materials they need to commence the work of the following spring.

If one end of a narrow tube of glass is inserted into water, the water will at once rise in the tube. If the tube is extremely narrow like a hair (Latin *capilla*, meaning hair—hence "capillary"), the water will rise for a considerable distance. Capillary action accounts for the rise of a liquid, but once the liquid has risen, there is no further tendency for it to move. Imagine a capillary tube of such length that, when one end is dipped into water, the water will rise in the tube and fill it completely. Experiment shows that there is no tendency for the water to flow out the other end. Imagine the upper end of the same tube bent in the form of a hook; though the tube is full of water, none of it will drip from the open end. Yet sap drips in spring from a grapevine which has been pruned and from an incision in the bark of a leafless maple tree. Therefore, though capillary action undoubtedly plays a large part in the economy of plants, it does not account for the flow of the sap, which moves because it has pressure behind it.

If water has risen in a capillary tube and is somehow removed from the upper part, more water will rise to take the place of that which has been removed, causing flow. The removal of water in this instance is, of course, accomplished by some means other than capillary action. And trees in summer are equipped with an apparatus, namely, the leaves, by which precisely this removal of water may be accomplished. Water evaporates from the surface of the leaves and more water is drawn up through the capillaries to take its place. The principle here may be illustrated by a simple and pretty experiment: Take a narrow capillary tube, the upper end of which widens to form a little cup. Dip the lower end into ink, so that the dark fluid rises through the length of the tube and into the bottom of the small cup. Now take the tube out of the ink and set it up with its lower end in a vessel of water. Put into the little cup, in contact with the ink which is there, one corner of a piece of filter paper which has previously been wet with water, arranging the paper so that the water on it may evaporate freely. As the water evaporates, the ink will be drawn onto the paper from the capillary tube, and colorless water will be drawn into the tube behind the ink. The line of demar-

MOUNT McKINLEY, ALASKA

◀ *From a photograph by Bradford Washburn, Institute of Geographical Exploration, Harvard University*

Charles Krutch

WITHIN THE SCROLL CASE

. . . of one of the two turbines at Norris Dam on the Clinch River in Tennessee. Water from the penstock passes through the wickets at the right, where it turns the propellers of the turbine

cation between the black ink and the colorless water can be seen to move up the tube. After a time all of the ink will be on the paper, while the tube will be full of water; still later the ink will have been driven to the outermost edges of the paper, where the evaporation is most rapid, and the paper will become white again, with the ink around its edges. Similarly, if the stem of a white rose is allowed to stay, say for half an hour, in a solution of some dyestuff and is then put into fresh water, the rose will finally appear with the color of the dyestuff along the edges of its petals.

Since the sap of a tree commences to flow before the tree has yet put out any leaves, evaporation through this medium can hardly be a factor in determining its movement. But the presence of sugar in the roots and the osmotic pressure which results when the snows melt and the roots are drenched with water, might appear to supply a sufficient explanation of the flow of the sap in early spring. If a lump of sugar is coated with a skin of collodion or wrapped tightly in cellophane or any other semipermeable membrane and is then put into water, the water will pass through the membrane and dissolve the sugar — and will continue to pass through until equilibrium is attained. In practice, by the pressure of the continually increasing volume of the solution inside of it, the collodion skin would burst. If the skin were very strong indeed, the osmotic pressure within it at equilibrium would be sufficient to prevent more water from diffusing through. Thus, if the semipermeable sac containing the sugar were attached to an upright pipe, the liquid would rise in the pipe, and the pressure within the sac would be the pressure indicated by the height of the column. Osmotic pressures are enormous. A solution of three-quarters of a pound of cane sugar in a quart of water has an osmotic pressure of about 20 atmospheres, enough to send a column of water to a height of some 600 feet — higher than the tallest tree. It might seem to be something of this sort which causes the sap to flow. If the semipermeable root tendrils of the plant contain sugar and if the roots are wet, water tends to pass into them, to dissolve the sugar, and to force it upward into the veins of the plant.

Water passing into the roots dissolves the sugar and carries it up into the plant. The sugar is removed from the root tendrils. What then causes more water to come in and maintain the flow? To this question there seems to be no ready answer. The investigations of Dr. Philip R. White in the laboratories of the Rockefeller Institute for Medical Research at Princeton, N. J. — investigations for which he has recently received an award from the American Association for the Advancement of Science — have demonstrated that tomato roots may be grown apart from the rest of the plant and that these roots (which presumably contain no sugar, for they have been grown apart from the photosynthesizing green parts of the plant) can nevertheless produce pressures which are large enough to account for the movement of sap in the tallest trees. And there the matter stands at present. The science of plant physiology has been advanced greatly by the recent proof that the old explanations are inadequate. Meanwhile Dr. White and his colleagues are continuing their research with the hope that improvements in apparatus and technique will lead to new knowledge.

Do Flies Shun Blue?

WHETHER or not flies — house, horse, or bluebottle — have any artistic sense can be of little interest to anyone but the flies. However, the observation that flies appear to dislike and even to shun rooms painted blue is of immediate personal interest to everyone who has ever had to share his ice cream with *Musca domestica*, the common housefly. Although the literature on the life and habits of flies sheds little light on the subject, there appears to be a well-founded belief in many countries that flies are unhappy in the presence of blue, particularly a medium or "implement" blue.

While traveling in France, G. B. J. Athoe, an English architect, found that the walls of most of the hospitals and clinics there are painted blue for the purpose of discouraging flies. Both architects and physicians in France supported the theory that a light blue is disliked by flies and is an effective method of keeping the insects out of sickrooms. Pursuing the subject further, Mr. Athoe found that abattoirs and factories built in Denmark by a distinguished Dutch engineer had bright blue interiors for the same purpose, a practice which the engineer had found successful in the kitchen of his own house.

A Frenchman some years ago conducted experiments on the color preference of flies, using a box, the walls of which were covered with squares of paper of various colors. Observations were carried on over a considerable period of time, and the box was turned in different positions in order to avoid error from other causes. After several days a count of the flies in the box showed that 18 of the insects had chosen to rest on a clear green paper. The next largest number had chosen rose for their resting place, with clear yellow, azure, and clear red following in that order. Only one fly was found on the ultramarine blue. No conclusions were reached as to why flies chose azure blue rather than ultramarine.

Charles Krutch

HARNESSING THE WATERS

Above. *Norris Dam's masses of concrete tower over the Clinch River* (below). *In time of flood, the spillway has confined a waterfall greater than Niagara*

As a result of his inquiries the English architect found that bright blue walls and ceilings have been found effective for keeping flies away in a number of English homes. One shrewd Englishman, suspecting that most flies enter the house via the kitchen, painted the walls and ceiling of that room powder blue, and found that this color barrier kept the rest of the house free of the flying pests. This practice is common in some South American countries and in parts of the West Indies where, in many instances, fly screens are not considered necessary when blue is used as a decoration.

Yellow Jack

SHARING the doubtful honor only with smallpox, if at all, yellow fever holds, in the history of the Republic, a position analogous to that of the plague in England. Our early civic history is crossed by its story. Freneau, the poet of the Revolution, memorialized it. Our first novelist, Brown, drew on it for background and for plot. Colonial and early Federal newspapers abound in references to it. The heroism of Walter Reed's group is a later focus of interest in this ill.

For many reasons, news from the Rockefeller Foundation concerning its war on the disease always is of headline importance. President Raymond B.

Fosdick's review of the foundation's work for 1937 stresses the importance of mosquito control as reinforced by the unpleasant knowledge that jungle yellow fever exists in regions in South America where *Aëdes aegypti*, the mosquito carrier, is unknown; that consequently there exists a "permanent reservoir of infection in the jungle"; and that human cases may be not essential but relatively unimportant in maintaining the jungle infection. Cities and towns in threatened regions must rely on control of the insect carrier. This method, however, is not applicable in the jungle infection, nor can the animal hosts of the jungle infection be eliminated. Vaccination with living virus to immunize exposed populations is the sole hope of prevention.

The brighter side of the story appears here, for the foundation's workers can report well over 40,000 vaccinations in South America during 1937, using a virus developed between 1934 and 1936 in the foundation's laboratory. Tests of the efficacy of the vaccination, made on some 700 individuals, showed full or partial immunity for over 99 per cent. "Efficient protection of populations exposed to jungle yellow fever is in sight," declares the review, and "the danger of the international spread of yellow fever through air traffic can be greatly reduced by immunization of air crews and passengers." Fortunately, the reaction to this virus is slight, rarely leading to more than a mild headache six or seven days after vaccination.

Even so, the foundation, through subsidizing construction of laboratory buildings in South American cities, admits frankly that many long problems remain for study before jungle yellow fever is to be mastered.

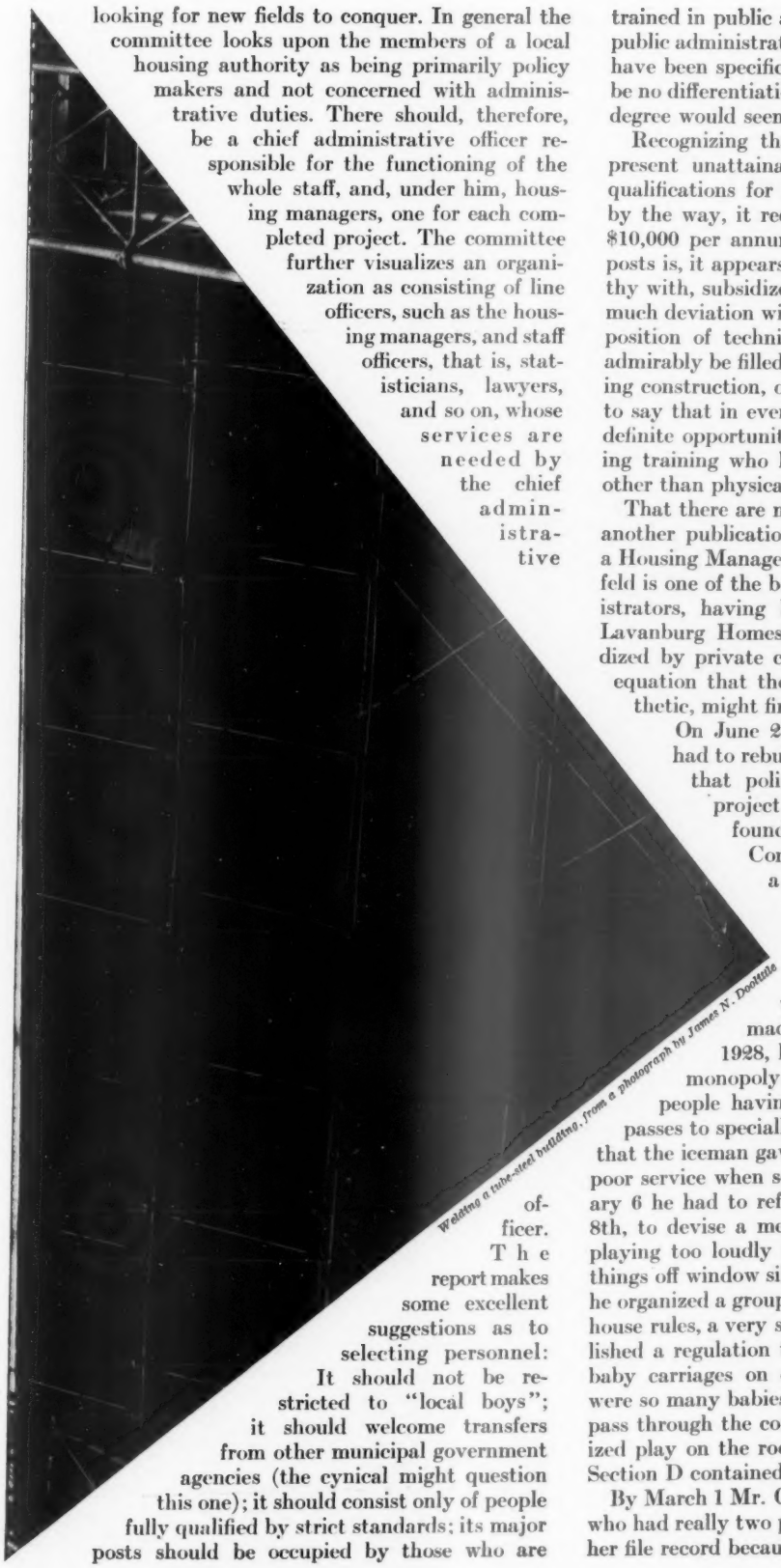
A New Profession

WHATEVER may be the final verdict of history on the New Deal, quite probably this regime has created new professions which will be increasingly popular with the passage of time. One of the latest fields in which a good living can reasonably be made is, it appears, in housing management. Before the Roosevelt administration there were, it is true, a scattered number of professional housers, but in general those who interested themselves in this subject did it as an avocation and with little hope of, or desire for, financial reward. How different the picture today!

Almost with the 1933 inauguration the housers got busy. The National Association of Housing Officials was formed at a meeting in Chicago in November, 1933. The meeting recognized the need for a central clearing house for the then-new class of public officer — the housing official. At first the membership was small, the bulletins scanty, the purposes somewhat vague, though a definite pressure on legislators on behalf of better housing was evidently a realistic intention on the part of the leaders from the beginning. But with Cassius one might well wonder on what meat this hath fed that it doth wax so great. In five short years the National Association of Housing Officials has become an important body. Its nominee now sits as head of the National Housing Authority. Its directors include many of those most prominent in housing officialdom. Its meeting of last fall in Cleveland flowed through the Hotel Statler with all the size and enthusiasm of a national convention of master plumbers. Instead of modest photostated bulletins, it now publishes a well-printed yearbook, maintains a correspondent in, and printed correspondence from, Washington, and has gone to a very considerable extent into the publishing business.

Subject of this screed is a fairly recent document, entitled, "Administrative Personnel for Local Housing Authorities," being a first report by the Committee on Personnel Standards. Though tentative and exploratory, since the field is new and complex, this report will nonetheless hold promise to technologically trained men

looking for new fields to conquer. In general the committee looks upon the members of a local housing authority as being primarily policy makers and not concerned with administrative duties. There should, therefore, be a chief administrative officer responsible for the functioning of the whole staff, and, under him, housing managers, one for each completed project. The committee further visualizes an organization as consisting of line officers, such as the housing managers, and staff officers, that is, statisticians, lawyers, and so on, whose services are needed by the chief administrative officer. The report makes some excellent suggestions as to selecting personnel: It should not be restricted to "local boys"; it should welcome transfers from other municipal government agencies (the cynical might question this one); it should consist only of people fully qualified by strict standards; its major posts should be occupied by those who are trained in public administration and who wish to enter public administration as a career; its staff officers should have been specifically trained in the field; there should be no differentiation between men and women; a college degree would seem desirable.



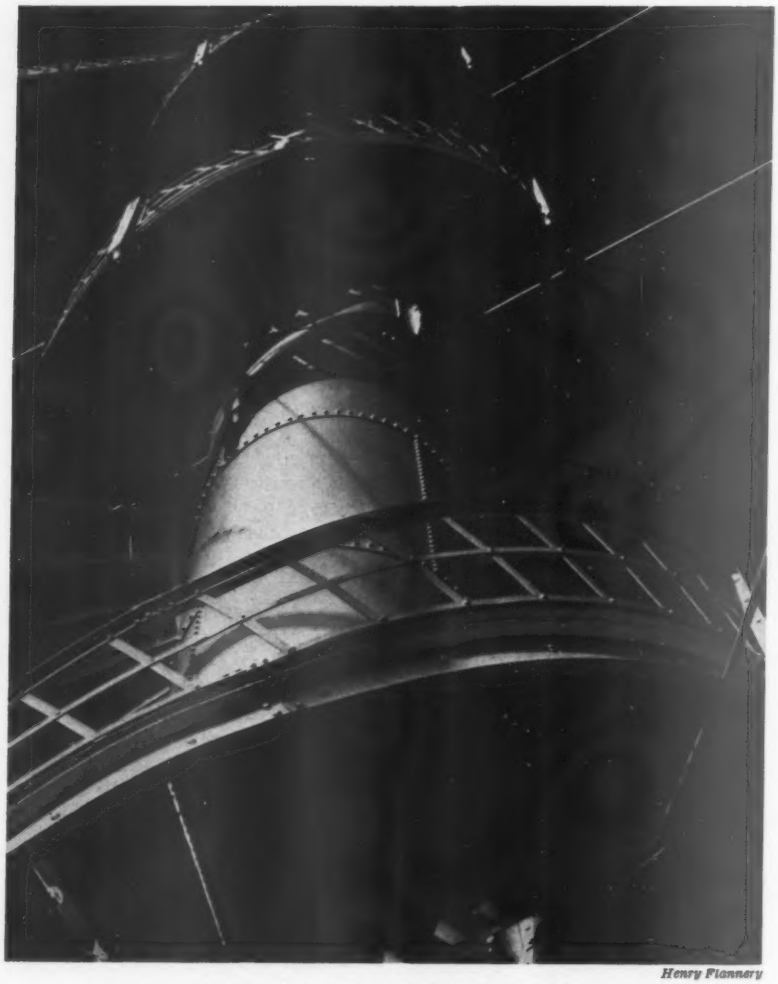
Welding a tube-steel building, from a photograph by James N. Doolittle

Recognizing that many of these desiderata are at present unattainable, the committee goes on to list qualifications for key positions — positions for which, by the way, it recommends salaries of from $7,000 to $10,000 per annum. The common requirement for all posts is, it appears, a full understanding of, and sympathy with, subsidized housing. Beyond this point there is much deviation with the job. Specifically, of course, the position of technical director is one which can most admirably be filled by a graduate in architecture, building construction, or civil engineering. But it is also fair to say that in every position discussed there should be definite opportunity for men with scientific or engineering training who know how to apply this training to other than physical factors.

That there are many such factors is well revealed by another publication of the N.A.H.O., "The Diary of a Housing Manager," by Abraham Goldfeld. Mr. Goldfeld is one of the best known of housing-project administrators, having been for many years head of the Lavanburg Homes, a highly successful project subsidized by private capital. His diary shows the kind of equation that the technological mind, if not sympathetic, might find difficulty in solving.

On June 25, 1927, for example, Mr. Goldfeld had to rebuke an applicant because she thought that political pull would get her into the project as a tenant; on July 2, a hot day, he found that whole families had left for Coney Island; on August 23 he planned a rejection card which would carefully skirt the real reasons for rejection — feeling, for some unexplained reason, that you could not tell a man he was rejected because his wife kept a filthy home or because he made too much money. On January 22, 1928, he undertook his first experiment in monopoly, when — to limit the number of people having access to the building — he gave passes to specially privileged tradesmen, only to find that the iceman gave short weight and the laundryman poor service when secure in their privileges. On February 6 he had to refuse a congressman a favor; on the 8th, to devise a method of keeping the children from playing too loudly too late at night, and also to keep things off window sills and fire escapes. On February 16 he organized a group of older boys to help him maintain house rules, a very successful venture; on the 23d, published a regulation that mothers could not keep their baby carriages on courts or sidewalks because there were so many babies that in fine weather one could not pass through the courts; on the 26th he started organized play on the roof; on the 27th, found the walls in Section D contained many hallmarks.

By March 1 Mr. Goldfeld discovered that Mrs. Gold, who had really two pairs of twins, had put down one on her file record because she was embarrassed. On March



Henry Flannery

Spiral stair and water tank from down under

9, the baby-carriage problem still being pressing, he arranged a sale of collapsible carts at reduced cost and this solved the problem; on the 25th, received Shalachmonus (gift of goodies) because of the Purim holidays. On April 2 he was constrained to report that a flowerpot, dropping off a prohibited window ledge, missed little Frieda Kirchbaum by barely an inch, whereupon Mrs. Kirchbaum had immediately paid a call on the pot dropper; on the 13th, contributed to a fund for the striking miners in Pennsylvania but admonished Mrs. Krentzman that she must carry a statement with her in making the collection through the building. On May 8 he had to smooth down Mrs. Goldman, who said that the neighbors above her were taking so many showers that the water came through and spoiled her bedrooms and she wanted so much bathing stopped; on the 10th, had to stop a fight between Mrs. Dubin and Mrs. Marcus, doing this sympathetically and sensibly. On June 24 he spent the day with engineering complexities of fuel buying and of boilers; on July 13 and 14, had a difficult situation to straighten out resulting from adolescence on the roof. On August 9 Mr. Goldfeld was held up in his office by three robbers.

It must be evident from these random excerpts from a very human, amusing, and interesting document — which, incidentally, far more than any biography, gives the picture of a man — that the job of housing manager is not one for the unsympathetic, the uneducated, or the weak. Technologically trained men who feel themselves to be none of these might well look into the matter further, because house managing is a profession which, in these times, seems more likely to wax than to wane.

Deepest

LESS than a year ago K.C.L. A-2 meant nothing to anyone but officials of the Continental Oil Company, which used these symbols to identify one of its new wells in the Kern County, California, oil fields. Today K.C.L. A-2 is famous as the deepest oil well in the world, for recently its drilling crew had plumbed the earth to a depth of more than 14,100 feet, an all-time record and 1,314 feet deeper than the McElroy well in Texas, the former record holder. Not only is K.C.L. A-2 the deepest, but it is probably the straightest well ever drilled, for at a depth of 11,500 feet the drill hole is only slightly more than 20 feet off vertical.

The fact that the world's deepest well had not tapped a large reservoir of oil at a depth of nearly two and three-quarter miles is secondary in interest to the feat as an engineering accomplishment. In addition to much valuable geological data, the drilling of K.C.L. A-2 raised new technical problems of special interest to the designers of drilling machinery. Although no special equipment was required for the task, new types of casings may be required for greater depths.

The record well was drilled to 14,100 feet in a total elapsed time of 259 days, during which the rotating bits encountered heaving shales, sand, and rock, and a temperature of 255 degrees F. at the bottom. Oil and gas at high pressures were encountered in the shales and greatly added to the problem of drilling. From the surface to a depth of slightly more than 8,000 feet, the drill was cutting through formations of Pliocene age, and from that depth on the shales and sands of the Miocene period were encountered. Heavy casing followed the drill and in one instance the drilling crew ran 11,573 feet of seven-inch casing in the remarkable time of eight and a half hours. The weight of the drill pipe and traveling assembly in K.C.L. A-2 was 210,000 pounds, the drill pipe alone weighing 190,000 pounds when suspended in drilling mud of a weight of 69 pounds per cubic foot.

The New Attack on Everest

Has It Any Scientific Significance?

By John E. Burchard

As these words are being written, a long chain of English sahibs, Sherpa and Bhutia porters is winding its way across Tibet, something more than two-thirds of the way from Darjeeling, where the march began, to Rongbuk, where it will end and where the serious business of reattacking the 29,141 feet of Mount Everest will begin. By the time these words are read, the travelers will, if all goes well, have set up at least the first three of the six or seven camps they will try to establish. These three camps — fairly substantial affairs of several tents — will be erected while the spring snows are still falling. They will be called "low camps," although Camp III will be on perpetual snow at an elevation of about 21,000 feet. From this camp the testing part of the Everest expedition will begin. Porters and climbers will establish progressively higher and progressively simpler camps until the final ones, beneath the northeast shoulder of the mountain, will be little more than wind-blown shelter tents and frost-bitten caches for food. Through the month of May and, with luck and a late monsoon, for a week or two in June, the effort will continue. During this period of relatively beneficent weather, one day in three may be good. When the monsoon, laden with rain for the tropic plains of India, finally reaches the Himalayan peaks, it will come in the form of blizzards which will shut off any further effort for the year. By mid-June this year's story will have been written.

Though named for Colonel Sir George Everest, surveyor general of India, who, as Lieutenant Everest of the Artillery, was one of the early surveyors carrying on triangulation work in the region, this mountain has become romantically associated with one man, Mallory, the mountaineer *sans reproche* who, after carrying on the preliminary reconnaissances, finally lost his life with Irvine in the mystery-shrouded disaster which ended the 1924 Expedition. Though the bearers of nearly all the great names of post-War British mountaineering have found their way to the mountain, though the exploits of Younghusband, Bruce, Longstaff, Ruttledge, Norton, Somervell, Smythe, and Odell have all been notable, still the mountain remains the mountain of Mallory. The 1934 Expedition found Mallory's ax under conditions which must, to the unprejudiced, weigh heavily against the probability that he gained the summit. Nonetheless, the belief that he did prevail is hard to cry down. It is an apocryphal legend, clung to with a fervor transcending logic. In this, as in many other respects, the quest for Everest takes on a religious aspect.

Everest is a purely British mountain. Though Nanda Devi, the highest mountain (25,600 feet) yet conquered by man, was climbed by a joint English-American expedition, though German and German-American parties have struggled vainly against Kangchenjunga and Nanga Parbat, Everest has been reserved by Englishmen for Englishmen on the theory that the psychological difficulties are so intense that it would be dangerous to add to them by the complications of mixed tongues, mixed traditions, mixed temperaments. Yet, though higher, Everest is probably no more difficult of achievement than Nanga Parbat or Kangchenjunga. The former offers far more difficult rockwork and has been the most vindictive in its toll on European life; the latter has the hardest and most vicious ice that man has yet encountered, is exposed to the bitterest avalanches, and enjoys scarcely any better weather than Everest — indeed it seems likely that it may be the last of the great peaks to fall. Again the religious parallel is evident, this time in the doctrine of "the select."

Actual attacks on Everest began in 1921. Up to that time no climber had been within 50 miles of the mountain. The south side fronts on Nepal, which for political reasons has kept itself closed to European expeditions. No European has seen the mountain from that side from below at close range, although the fliers of the *Houston-Westland* expedition did fly toward it across Nepal. Mallory, who led the first climbing reconnaissance in 1921, was forced, therefore, to approach the mountain from Rongbuk in the north by a route which has been followed in essentials by every subsequent expedition. This route brings the explorer face to face with the mountain, looking south from the foot of the East Rongbuk Glacier. The summit from a base camp at this point exposes a net elevation of 13,000 feet or of Mont Blanc scale. But the difficulties of spanning that elevation are vastly increased by cold, by weather, and by the psychological and physical effects of high altitude.

From the summit of the mountain there are three main ridges: one running northeast, one approximately south, and one a little to the north of west. The triangle between the northeastern and southern ridges includes the east face, which every climber concedes to be insurmountable. That between the northwest and southern ridges has not really been reconnoitered, although it is known that an inaccessible precipice cuts off the northwest ridge from the south face, and it is also known that the net climb via the south would be materially greater. In the third, or north, sector most of the exploration has taken place and every attempt at the summit. Here, too, the current act will be played.

IF EVEREST IS SCALED, THE WORLD IN A SENSE WILL HAVE LOST SOMETHING — A TINY OBJECTIVE, PERHAPS, BUT POSSIBLY AN IMPORTANT ONE FOR THE SPIRIT. BUT IT WILL HAVE GAINED, TOO . . .

Some distance out the northeast ridge from the summit at a perceptible shoulder, another sharp ridge forks and descends slightly west of north to a saddle, whence it bends still farther west and ascends to the North Peak. It is this North Col which has seemed to all the climbers to be the vulnerable point. Mallory's early reconnaissance was carried out from Rongbuk Glacier, the head of which lies west of the North Col, sheltered between the almost parallel northwest ridge and that leading to the North Peak. He soon found that the 3,000 feet from the glacier to the col was very difficult, if not impossible, to scale and switching his exploration found the East Rongbuk Glacier slanting off to the east from the North Col. It is on the north edge of this glacier that Camp III will, as in the past, be pitched.

The glacier itself, though enervating, has so far stopped no one, and an approximate site for Camp IV has been well up the east wall of the North Col. From this camp the climbers reach the face edge and set Camps V and VI just in the lee of the northeast shoulder. The site may vary slightly from expedition to expedition, with a tendency to set it higher each time. So far, all the assaults have been carried on from this point without benefit of further camps, and it is in the final 3,000 feet (or, in the case of the 1934 Expedition, the final 1,600 feet) of altitude between Camp VI and the summit that the story of Everest has really been written.

There have been, of course, exciting enough moments in other portions of the climb. In 1921, because of their explorations on the other side, Mallory and Bullock did not approach the North Col from the East Rongbuk Glacier until late September, after the monsoon had passed. Though the weather was fine, it was extremely cold, and this season has never been tried again. Mallory and Bullock easily mounted the 1,000 feet to the col in one day but were here forced back by the winds, and this terminated the 1921 Expedition, which had demonstrated that there was a way to the saddle. No other party of climbers has found this part of the climb so simple, and indeed it took one party nine days to ascend the same 1,000 feet. In comparing these achievements it must be remembered that it is part of present technique on Everest to set all the camps, except the very highest, with porters, saving the climbers as much as possible for the final waves. The climbers must therefore often set ropes and cut unusually deep steps and even resort to rope ladders to make the passage possible for the heavily laden bearers.

The 1921 Expedition was largely exploratory. That which followed in 1922 was extremely strong. Led by General Bruce, it included, besides Mallory, Dr. Somervell, Dr. Longstaff, and Colonel Norton. The question of oxygen had now been raised, and midst divided opinion one party used it and one did not, with no demonstrated results either way. A nonoxygen party of Mallory and Morshead reached 27,000 feet, and the party of Finch with oxygen went slightly higher. This expedition of 1922 ended in disaster due to an avalanche on a simple slope which carried away several porters. Accidents in mountains quite usually occur when least expected. The reader will recall Whymper's similar experience after the conquest of the Matterhorn.

Mallory had always felt that the way to the summit would lie along the ridge from the northeast shoulder to the top. Two climbing obstacles lie in the way, walls of perhaps 100 feet each which have been called the First and Second Steps. The 1924 Expedition, led by Mallory, naturally chose the ridge route. Despite atrocious weather, which held the climbers up at every turn, Mallory and Irvine finally set out up the ridge. Disappearing in the clouds, they were never seen again. Odell, trying rescue, twice attained 27,000 feet solo and without oxygen on subsequent days, but was forced back by time on both occasions. Then came the monsoon. (*Continued on page 324*)

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Mechanical Tests for Drivers

Are They of Value in Promoting Safety?

By Harry R. DeSilva

MEASURING BASIC FACTORS IN DRIVING SKILL—HUMANIZING APPARATUS—DRIVER CLINICS—PRESCRIBING FOR THE INFERIOR DRIVER

WHEN intelligence tests were first introduced, they had their detractors and their overardent zealots. Having lived with intelligence tests longer, we appreciate their value but do not expect them to do the impossible, such as predict an individual's success in afterlife. We do, however, find them useful in helping a skilled vocational expert to counsel the individual to avoid certain fields of activity where he will be unduly handicapped. Similarly, driver test apparatus in the hands of a skilled operator can render valuable service to drivers. But like instruments of the physician or surgeon they must be expertly used. Equally important, the results therefrom must be interpreted by an experienced person. Used in a professional fashion, driver test apparatus will yield additional information which to an expert with his unaided senses would remain forever hidden.[7]*

Apparatus makes for more detailed, faster, and more comprehensive observation. Scientific instruments increase the objectivity of diagnosis and produce results which can be standardized. Last but not least they increase the confidence of the subject in the clinic supervisor. Driver apparatus gives a more accurate measure of some of the basic factors that go to make up driving skill, such as eye-hand coördination, speed of reaction, and visual efficiency. The eye-hand coördination of an individual can be determined by making him carry out certain prescribed operations. The steering test developed by the Harvard driver research laboratory is useful both in standardizing the set of operations required of the driver and in measuring his coördination more carefully than could be done by unaided human observation. In other words, the apparatus standardizes the conditions of performance, repeats them uniformly for each individual, and measures in objective units the subject's efficiency.

We have available apparatus which measures activity too fast for the human eye to evaluate.[4] The average person takes only about 0.4 second to see a signal and move his foot from accelerator to brake. The machine we have to measure braking reaction time is accurate to within .01 second. Quickness of reaction is a fundamental part of all skilled performances of humans. Such a measure of fractional seconds is possible by a scientific instrument but not by direct observation. Normal eyes recover from glare in a matter of a few seconds. Without apparatus we could not reproduce uniform conditions and measure the recovery time.

More comprehensive observation is possible with mechanical tests. Automobile driving continually calls for the ability to do several things at once or in quick succession. Our vigilance test equipment enables us to present a succession of different tasks, offer the subject a variety of different ways of responding, and then obtain a measure of his skill. No person without the assistance of apparatus, regardless of how experienced and expert in driving he might be, could possibly observe and estimate accurately and uniformly the ability of a driver to apprehend and carry on several things at once.

The most objectionable feature of the road examination for drivers is the presence of the examiner. He makes people nervous. He is human and therefore subject to personal likes and dislikes. Having limited powers of observation, he makes his judgment not on the basis of measurement but on opinion. In contrast, apparatus is objective. An instrument gives measurements, not opinions. It is consistent and treats everyone the same. It is impersonal and therefore elicits a constant attitude rather than variable personal attitudes on the part of the subject.

FIG. 1 TESTING VIGILANCE

By presenting a succession of different tasks and providing the driver with a variety of different ways of responding, this equipment provides a measure of driving skill

Just as we have standards of performance in golf, tennis, and bowling, so do we need standards of performance in automobile driving. But we cannot measure driving in terms of speed or accuracy or even by comparing ourselves with experts, since we have standards of excellence. Our driver apparatus, however, measures basic factors in automobile skill and furnishes us with standards. To be sure, the most skillful driver is not always the safest driver. But the least skillful, ignorant driver is nearly always an unsafe driver. Moreover, the average person is practically always low on some sensory or motor capacity. Unquestionably

* Numbers refer to notes at end of article.

FIG. 2 TESTING VISION

Many supposedly normal adults have visual defects of which they are ignorant. This equipment, together with that shown on the preceding page, covers the 12 tests listed on the profiles shown on the opposite page

he should be taught to recognize that weakness and to try to overcome it or compensate for it. In the process he may be led to recognize the need for sportsmanship in driving and thereby improve his attitude as well as his skill.

Knowledge of their own relative efficiency of performance is particularly needed by inexperienced young drivers, by elderly drivers, and by defective middle-aged drivers. Youngsters have not driven enough to learn to be cautious. Neither pecuniary loss nor injury from accidents has had a sobering influence. Youngsters should be shown their poorer coördination (young people do less well on the steering and vigilance tests than adults) and their numerous visual defects. They should be brought to realize that all cannot drive equally well and that study and concentrated effort are just as necessary to skill in driving as to excellence in sports.[3]

We have discovered that most elderly persons are ignorant of their failing abilities. Results on all apparatus show decline of ability from 35 years onward. It is surprising how many supposedly normal adults have visual defects of which they are ignorant. For example, a Californian study showed that 20 per cent of fatal-accident operators had suppressed vision on one side, and that nearly every collision occurred on the side of the inferior eye. Adults, with their greater wisdom, accept objective facts about their ability as readily as youngsters. For this reason driver test apparatus with determined standards of performance for different age groups is particularly effective in convincing older persons to slow down, drive less at night, and in general exercise more care to compensate for decreased skill.

We are all primarily interested in ourselves. Driver test equipment informs us about ourselves, not in general terms but specifically by comparison of our performance with that of the average person. Few drivers are perfect. Ordinary drivers usually accept the challenge to improve after learning about their weak points. For example, practice on the steering test brings about an improved performance. Similarly, steering a car around corners, taking curves, and backing into a parking place can be improved with practice. Braking reaction time, on the other hand, cannot be changed. But vigilance, or alert and accurate responses to changing conditions, can be improved with experience and by taking seriously the task of driving a car. If, after practice, drivers find themselves still unable to improve, they can compensate by driving more slowly or by avoiding heavy traffic or other hazards. Driver clinics are, therefore, valuable for normal adults as well as for young and old persons.[5]

Just as a man is judged by the clothes he wears, and the workman by his tools, so the driver clinic supervisor is judged by the professional appearance of his apparatus. There is a prestige value to apparatus. Psychologists have for years been using various gadgets for measuring reaction time, coördination, and various sensory capacities. The more scientific the appearance of the apparatus, the greater the impression on the subject; haywire devices have never emerged from the laboratory because of their appearance. Driver apparatus, last but not least, adds a professional halo to the clinic supervisor, just as the bag of instruments adds immeasurably to the front of the physician.

All too often apparatus for testing humans is designed and constructed by a mechanic who has never and will never use it on the general public. Our experience of over four years in devising and putting driver test apparatus into practical use has impressed us with the need for coördinating the design, construction, and use of the human testing equipment. No human testing instrument can be designed on the drawing board and be expected to work out successfully in practice. Few engineers have ever really set out to build apparatus around the human being, nor do manufacturers appreciate the wisdom of adapting apparatus to the public before putting it on the market. Most apparatus is designed solely to meet certain economic or engineering specifications. It is high time design engineers started to study John Q. Public instead of leaving him to the tender mercies of the sales staff.

Human beings, unlike inert matter, cannot be slapped into a machine, subjected to various tests, and ejected: The subject must first be given instructions and be interested in taking the test; he must be told what to do and how to do it; and he must be sent away feeling that he has been helped. Each subject is unique. He approaches the test with different attitudes and adopts different methods of carrying out his task. The supervisor is all important in adjusting the subject to the apparatus.[9] The instruments themselves, however, are not unimportant. The equipment should interest the driver. If it strikes him as unreasonable or calls for performance too remote from the activity it supposedly tests, he often fails to put forth his best efforts.

To duplicate road conditions in the laboratory in order to please the subject is obviously impossible and unnecessary. But we can simulate some driver conditions, such as the car lights and pedestrians in our glare test, or the road scene in our steering test. A couple of years ago we constructed a motion picture driving test to measure steering coördination. While it simulated road conditions more perfectly and proved more interesting to drivers, it did no better job of distinguishing between the good and poor drivers than our very much simpler steering test. This finding, together with the high cost and the great bulk of the moving picture test, made us give up this method as impracticable.

Americans are said to have the most highly developed sense of competition of any national group. One way in which this manifests itself is their inveterate tendency to try to "beat" the test. To counteract this we have adjusted our tests to make cheating impossible. For example, on our braking reaction test the interval between the time of applying the foot to the accelerator and the appearance of the signal light is made irregular by a control device. In addition, if a person lifts his foot before the signal appears, the test will not operate. These two features assure accurate scores, as they make it impossible for anyone to beat the test. Similarly, on the glare and other visual tests, we require the subject to tell us not only that he sees but what he sees.

A test should be difficult enough to challenge the ability of the most skillful operator. The least skillful operator must also be able to make a creditable performance. Otherwise he will resent the test and it will affect his attitude toward subsequent tests, nullifying the educational value of the clinic as a whole. For example, our steering test is adjusted so that within a total range of 100, the best person can make the 90's; the average person, the 60's; and the poor person, the 30's.

Experience has shown that on most tests the majority of individuals, comprising sometimes 80 per cent of the total, do not vary greatly in their scores. A good test should not give the majority of average persons the same score. Ordinary persons like to see some differences in scores among themselves. For example, we have found that braking reaction scores must be measured not in 1/8 seconds but 1/100 seconds, to differentiate between average persons. The accuracy of apparatus must be at least great enough to satisfy John Q. Public's curiosity in comparing himself with his fellow men.

Apparatus should be built for the subject. The task should be capable of being sized up quickly and the control devices, simple and natural to use. On this account we use a regular seat, steering wheel, and control pedals on our vigilance test. In our glare test the subject is told where to look for the pedestrian. Otherwise chance will influence the score on the glare recovery. Similarly, we give 20-second practice periods before starting on the vigilance test to show the subject how the test operates. Drivers cannot be vigilant on the test or on the highway unless they know what to expect and have an automatic reaction pattern to utilize in an emergency. By practice, persons can improve their ability on the vigilance test, just as they can improve their ability to be alert and to respond skillfully at all times at the wheel of a car.

Last but not least the apparatus should be adapted to the operator. The dials should be easy to read and the switches accessible. Having to spend a minimum of time managing the apparatus, the operator is left an opportunity to observe attitudes and unusual behavior of the subject. Personality traits and attitudes never obtainable in an interview are often revealed in the process of taking the vigilance test. Recording devices frequently reveal additional information not shown on indicating instruments. On the other hand, recording (*Continued on page 326*)

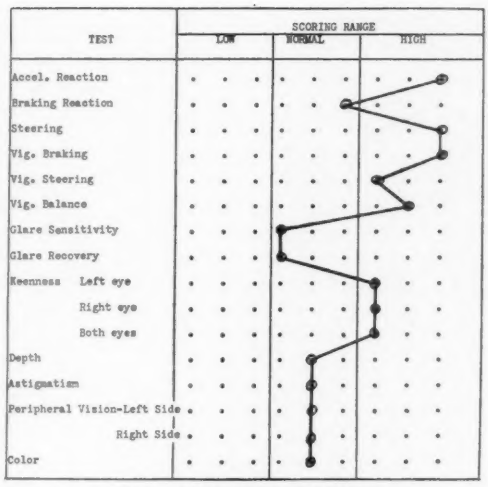


FIG. 3 SUPERIOR DRIVER

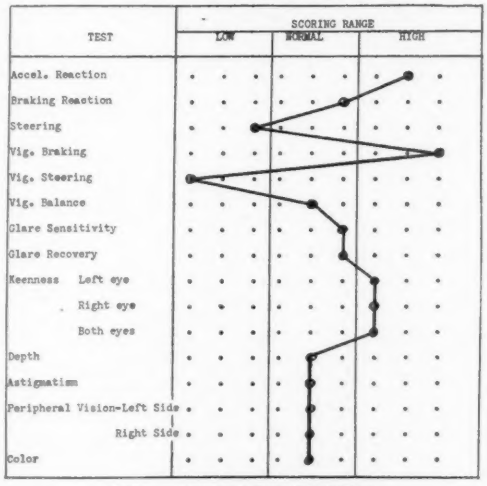


FIG. 4 AVERAGE DRIVER

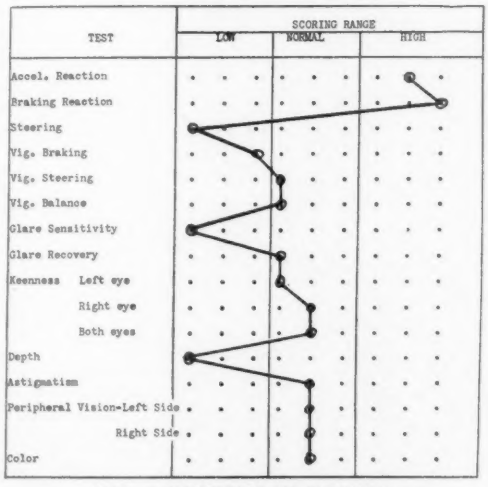


FIG. 5 UNSKILLFUL DRIVER

The composite ratings in the three profile graphs above consolidate the results of all tests on each individual, provide a diagnosis of the subject's strengths and weaknesses

Benjamin Franklin experimenting with electricity, a sketch for a larger picture never painted, by the famous 18th Century American painter, Benjamin West, the bicentenary of whose birth was recently celebrated

Philadelphia Museum of Art

Science and Culture

Does the Dignity of Life Become Greater As We Learn More of Its Complexity?

By Frederick G. Fassett, Jr.

A FEW months ago, as everyone knows, one of the Mussolini boys was wrought to poetry by the sensation of pure beauty which he experienced at releasing a bomb from his airplane and watching it blow up a group of African horsemen in an explosion that resembled the unfolding of a rose. Himself the product, as far as eminent position in world affairs is concerned, of the industrialism of the 19th Century, the young Vittorio employed, in his poetic interlude, machines embodying the coöperative contributions of scientists and engineers from all parts of the civilized world and employed them to bring civilization to hitherto benighted regions.

A few months hence, goggle-eyed Eskimos beyond the arctic circle may pause for a moment from more material concerns to look with uncomprehending curiosity at another "bomb," a spherical shell filled with a half ton or so of lead, in the heart of which is buried a container filled with argon. The inert gas in turn will inclose a delicate device that at intervals will register the receipt of an unseen, unknown, uncontrolled impulse delivered by the penetration of a cosmic ray.

These two random examples illustrate the range — in geography and import — of scientific undertaking in the world. The first of them, though graphic, is easily misinterpreted if it is regarded alone, without its compensatory corollaries. Inoculation against fever, for instance, may follow the bombing plane. That the bombing plane is the most vividly ubiquitous example of applied science in the world at present, is the fault not of science as such but of nonscientific applications of it. The cosmic ray bomb, which just sits there silently working, is a less spectacular but probably even more important example of scientific undertaking, this time of abstract science, which takes as its province not merely a world but a universe.

Implicit also in these bombs are reasons why it is not presumptuous for me to use in 1938 a title employed in 1880 by so powerful a mind as Thomas Huxley. Although the fundamental comparison expressed in it remains the same, the first term has undergone such great alteration that the two taken together now involve reasoning and material far different from those of a half century ago. The difference is enough to insure

the modern questioner against imputations of rashness or impertinence. If we take "culture" to mean the general philosophic aspect of our civilization, we find it pervaded by science to an extent imagined by a few, but scoffed at by the many, in Huxley's day. Whilst he was perforce seeking to show that the two are not mutually repellent, we can afford to ignore that question as settled and to be concerned with the results of the interpenetration.

WE are inclined to look on definitions as fixed and final, and to believe that once we have tagged a thing or an idea with a phrase describing and limiting it, the thing or idea must *ipso facto* remain what we have decided to call it. This sort of delusion is in a large measure a good and desirable thing; except for it, we should have a rather hard time understanding our world. But it can easily be carried to a dangerous extreme and result in trouble. Because of the facility with which we can — in our own estimation — pin an idea down with a label, or approximate an idea with a definition, we are led to treat not only the label but the idea, also, as a definite, measured, fixed, final entity, to be juggled as we will but not to be essentially altered without our permission. The words, we think, mean one thing, and what they mean is the thing defined, and the thing defined is one thing.

But the words, as such, mean nothing; they are merely crystallizations from a solution, and when the solution is culture, they are very unstable crystallizations. Such terms as "the western culture," "modern culture," and "the culture of European and American nations" mean nothing in themselves; they are philosophical approximations which we set up for convenience in apprehending the milling, unstable, constantly shifting complex of social forces constituting civilized life as we live it. Unless conveniently collected in some such inclusive term, the quicksilver would elude us. Since at any one moment civilization, or civilized life, by the introduction of some new element or the extinction of some old element, is being altered from its state of the immediately preceding moment, these definitive terms — as we fondly regard them — are constantly undergoing a revision of meaning. Though the pattern of vowels and consonants remains the same in the definition, the latter represents (or embodies, if you prefer) a fluid meaning which changes continuously.

These revisions of meaning, of both major and minor consequence, occur after and through the readjustments which take place when the complex or idea defined is altered to accommodate the accession or the loss of a component. This process occupies three rather clearly marked stages, which are curiously analogous to the phases of an infant's perception of external objects. The three stages are plainly illustrated in the gradual incorporation of functional modernism into architecture. They may be labeled — and with all our previous caveats in mind — as recognition, appropriation, and assimilation. The first occurs not when the elements of the new force are devised or assembled but when, possibly after a considerable period of unperceived or unsensed operation, the force is recognized as such, often through the proselytizing efforts of some of its practitioners who have become annoyed at the inertia of the general mass. Functional modernism in architecture — or the applications of what was to be called functional modernism — had been in existence and in effect for some years before, in the early 1900's, Frank Lloyd Wright led in forcing its recognition. We are now, presumably, emerging from the second phase, that of the appropriation of functional modernism, a period of uncontrolled adoption with insufficient critical restraint, consequently a period of ungoverned applications and intolerant impositions upon other elements making up architecture as a whole. It is probably fortunate that many of the monuments of appropriation are built of wire and plaster rather than steel and concrete. Now beginning, if you are optimistic, is the period of assimilation, during which — as a result of critical control, self-applied — adjustment and compromise are made, and the abuses of appropriation are corrected. Though functional modernism after this third phase may never exercise supreme sway, no completely self-conscious architect after this period can escape being to some degree a functionalist. The meaning of architecture thus will have been revised in response to the accommodation of a new force into the complex which it embodies.

This particular accommodation — of major importance for architecture and hence producing a major revision of meaning in that definition — is a fair example of minor accommodation and revision in culture as a whole and of the stages of a process constantly occurring for one or another of the forces making up that whole. The absorption of functional modernism into architecture may be expected to produce differences in the product of architecture, much as the absorption of science into culture will produce differences in men. For it is through their expressions — on the one hand, buildings; on the other, individualities — that such abstractions as "architecture" and "culture" have their effects on us.

When we are concerned over culture, then, though the argument may be made in most cosmic terms, fundamentally we are alarmed, or anxious, or skeptical over probable consequences in culture as it comes home to us, that is, consequences in the culture of individuals, other men, and ourselves. Whatever may have happened to anthropomorphism in matters divine, theological, or supernatural, at least the anthropocentric purpose still is dominant in institutions and conceptions of human origin. With certain manifestations of disposition, certain ways of behavior, which we attribute to the operation of culture as we define it, are we concerned. The definition, even when reduced in purview or intention to the single individual, remains an abstraction and, as such, is not immediately tangible. Manifestations of those qualities in which the abstraction is expressed are tangible, however; our alarm, anxiety, enthusiasm, or skepticism arises over expected alterations in these, for by such alterations the course of our own lives may be affected.

The assimilation of functionalism, we have said, means that no fully self-conscious architect can henceforth escape being to some degree a functionalist, and that, therefore, his effect on other men must be a differ-

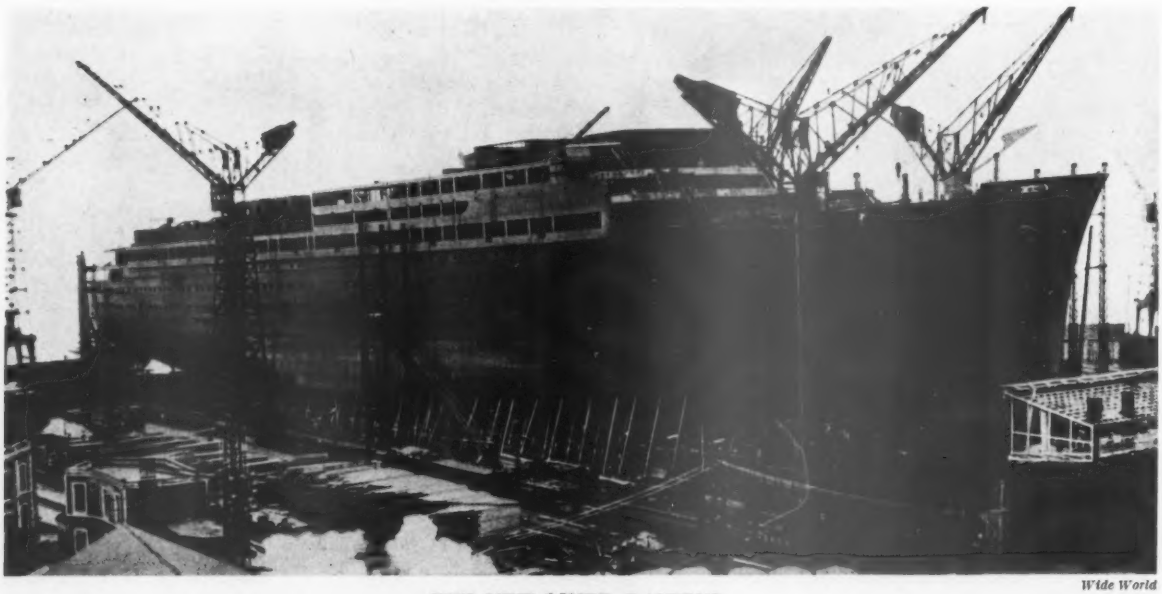
ent thing because of that assimilation. So it will be with the final assimilation of science into culture; the influence of the cultured man upon others will be a different thing because of it. As abstract architecture remains an abstraction, of immediacy only in its concrete manifestations in terms of building and, hence, principally in terms of its operation through the mind, philosophy, or approach of the practitioner, so culture as a general term is an abstraction, important to individuals only through the results attained by its practitioners.

Phrases used to summarize what we understand as a cultured individual suffer the same disabilities as the general terms we have talked about. They are approximations, endeavoring to hold together a number of variables and a few constants expressed through the variables. Culture, as regards the individual, we are told, means a heightened awareness of meaning, of significance, and of beauty. Meaning, significance, beauty are the variables in this formula; awareness is an inclusive constant, covering three underlying concepts. These are cultivation, appreciation, sympathy.

Even the most thoroughgoing disciple of Rousseau finds in culture thus defined a quality essentially artificial in that it is something beyond spontaneous, intuitive perception of beauty and meaning. The fact that it is an intensifying of natural potentialities implies the first of our three constants. The etymology of the word is truthful. By cultivation, deliberate or accidental, are fostered higher sensibilities; by cultivation man raises his appreciative capacity from the level where a sunset is the acme of beauty and an arithmetic progression is the limit of perceived meaning. By the same process he develops poise and equanimity beyond the stage of "native dignity." Now cultivation implies a means. It is not enough to shadowbox with the soul in a vacuum. To the middle of the last century, the means had been a primarily humane and anthropocentric set of studies, man-focused even to the extent of an anthropomorphic religion. Given original humane predisposition — which is hardly an impossible assumption — it was and is inevitable that cultivation employing such a means should intensify the quality of sympathy enough to make it the third of our constants. Human hopes, fears, sorrows, joys, expressed in all the media which human ingenuity had been able to adapt to use and remaining fundamentally the same from age to age — it was upon these that the individuality was tried in the course of cultivation. The clear consequence was a heightened sympathy. This we may define as including greater social consciousness, greater responsiveness to other than self-interest, and, hence, as the intellectualization of natural tolerance and good will.

The antagonism called forth by the recognition of science as a major force in our culture, the phase of its absorption which took place during the past century, resulted from two factors. First and less honorable is the resentment of interests vested in a definition of culture crystallized for centuries, and of institutions based on that definition. The task of science has not been made any easier by the well-intentioned but misguided among its supporters who attacked these institutions as anachronistic and futile. They might better have saved their power for the real task. The second array against science is less definite and approachable. Often inarticulate and at best so emotionally stated as to be incoherent, this is the belief that the rise of science will redefine individual culture so that sympathy will be of greatly reduced value, if indeed it is included at all.

THE scientific discipline in the modern sense is younger than Shakespeare, younger by a half century than the colony of (*Continued on page 328*)



Wide World

THE NEW LINER *PASTEUR*

One of the few ships that bear the names of scientists — the 30,000-ton liner built for the France-Argentina service, ready for a sidewise launching at St. Nazaire. She was christened by Mme. Pasteur Vallery-Radot, whose husband is a grandson of Pasteur

Apprenticed Sunlight

The Role of the Physicist in Creating Wealth Through a Better Understanding of Nature

By George R. Harrison

THE SOURCE OF EARTH'S ENERGY . . . HOW THE ATOM SPLITTERS OF YESTERDAY PROVIDED THE SALT WHICH FLAVORS LIFE TODAY . . . THE SHORTSIGHTEDNESS OF PRACTICALITY . . . REPLACING NATURAL RESOURCES BY INTELLIGENT RESOURCEFULNESS

THE energy which keeps the wheels of civilization turning has all come to us from the sun, whether we draw it from a gasoline tank, a storage battery, a ton of coal, or a pound of butter. So long as the sun keeps shining, we appear to have little cause to worry about running out of energy, and the best evidence indicates that our powerhouse in the heavens will still be glowing brilliantly a billion years from now. Unfortunately, however, most of the energy we are now using came from the sun in ages past, and we are drawing heavily on the earth's savings account of coal and oil instead of using our current energy income. Even though the sun sends us 20,000 times as much power as we need, most of it slips through our fingers, merely because we have not yet learned how to convert sunlight efficiently into those forms of energy which are useful for civilized living.

Whether yesterday was sunny or cloudy, a June day or a day in December, enough energy fell on earth during that 24 hours to serve humanity for a century — enough to keep the world's furnaces roasting and its refrigerators icy, to spin its wheels and refine its ores, and to fill for a hundred years every other need for power. Select on a map any convenient desert and look at an area 10 miles wide and 20 miles long — an area which would about cover the sprawling environs of a big city. Year after year enough sunlight is lavished on this small, sandy waste to satisfy perpetually the power needs of the entire population of the United States at the present rate of power consumption. In fact, to obtain energy equivalent to that swallowed in one hour on a sunny day by any single square mile of land or sea, grimy miners must now dig 500 tons of coal from the gloomy depths of the earth.

Energy is free — to him who can find how to capture and use it. But energy is wealth and, in the case of apprenticed sunlight, wealth of a particularly desirable kind, for it is freshly created and does not involve robbing the poor, taxing the rich, or despoiling the earth of materials which may be needed by our descendants as much as by ourselves.

The scientist who is most concerned with the investigation and control of energy is the physicist. In his researches on energy this scientist works very closely with the chemist, who is interested primarily in matter. Matter and energy are alway closely related, and physics and chemistry — originally a single science called natural philosophy — can never be separated completely, for they are the twin sciences which deal with the fundamental structure of our physical universe.

The chemist gathers the minerals and fibers and oils which he finds in nature, reduces them to the elementary atoms of which they are composed, and then causes these atoms to recombine into thousands of new kinds of molecules which form new perfumes and dyes, new flavors and fabrics and drugs.

The physicist takes apart the very atoms themselves, sending through wires the electrons which he thus collects, operating with them his telephones and x-ray tubes and television outfits. Or he may induce the atoms to emit light rays of strange new colors. These rays he bends with lenses cleverly designed to enable him to discern objects which are too dark or small or transparent otherwise to be seen.

As the physicist has gradually learned to control the grosser forms of energy, such as heat and sound, he has been led to probe deeper and deeper into nature to study the behavior of energy in its finer and more subtle forms, such as light and electricity and magnetism. He has now succeeded in penetrating through the atom into its tiny nucleus or core, and one of his principal interests at the moment (though by no means the only one nor necessarily the most important one) is to take sample atom cores apart to see what they are made of and how they are put together. The atom is being taken to pieces quite literally, for when one of the modern atom-smashing devices is put into operation, the atomic debris comes flying out like dirt from a squirrel hole in which a very industrious puppy is scratching.

This rapid development of one of the more spectacular phases of physics has led to the opinion, sometimes expressed by critics, that physicists are a little group of willful men who insist upon smashing atoms and doing other such useless tricks, when they might much better be giving their attention to matters which would be of greater practical value to the world. From the standpoint of the sociologist, says one popular scientific writer, the atom splitters have not done much to earn their salt. To those who survey the facts, however, it should be apparent that it is to the atom splitters of yesterday that we owe much of the salt which flavors life today, and that the atom splitters of today (using the term broadly to cover fundamental research into the structure of matter and energy) are now earning much of the salt of the next generation. After all, it is hardly reasonable to

Steam Plant — from a photograph by James N. Doolittle

THE WHEELS OF CIVILIZATION

. . . are kept turning by the energy which comes to us from the sun, whether we draw it from a gasoline tank, a storage battery, a ton of coal, or a pound of butter

accuse all physicists of being impractical if as soon as any worker in physical science does anything practical he is called an engineer and no physicist!

This reputation of the physicist for impracticality is enhanced by the interval of a generation or two which usually elapses between the discovery of a new physical phenomenon or the verification of a new theory and its utilization for practical ends. The great developments of radio, talking motion pictures, the long-distance telephone, and dozens of other advances which now add pleasure to the lives of millions are possible only because of discoveries made by academic physicists in the period 1885 to 1900, discoveries which have been applied by industrial physicists in the intervening years.

The scientist who appears preoccupied with the center of the atom is burrowing after the key to the structure of matter and energy, not because he expects to tap the energy in the atom but because he knows that before nature can be controlled she must be understood. The physicist who is engaged in pure or fundamental research is attempting to understand nature. The applied physicist is attempting to control nature. The two kinds of investigators must keep in close collaboration, for physics is a vast science which ranges from the very theoretical (like relativity) to the intensely practical (like telephony), and its workers have ranged from Einstein to Edison.

The casual newspaper reader usually takes a tolerant attitude toward the "impractical goings on" of the academic physicist. Discoveries made inside the cores of atoms — smallest known particles in the universe — have a certain elemental grandeur, and it is, the layman feels, a sign of cultural affluence that a practical world can afford them, just as in the past the world has been able and willing to support a reasonable number of poets. But occasionally a hard-souled skeptic boils over and writes his newspaper a protest against spending money on such foolish games. Why, asks he, should we support experts on relativity who want to calculate the properties of warped space-time, while so many slums and tenements are producing warped lives in the space that we have?

The simple practical truth is that experience has shown no better way of permanently abolishing slums than by well-directed atom smashing. Poverty can best be abolished by replacing it with wealth, and the systematic investigation of matter and energy without regard to immediate practical ends has turned out, strangely enough, to be the most royal road to social riches. In the long run, digging for truth has always proved not only more interesting but more profitable than digging for gold. If urged on by the love for digging, one digs deeper than if searching for some particular nugget, and much gold is usually produced eventually as a by-product. Practicality is inevitably shortsighted and is self-handicapped by the fact that it is looking so hard for some one objective that it may miss much that nature presents to one who is purposefully digging for whatever may turn up.

Wealth consists ultimately of the control of matter and energy. The wealth level of mankind is slowly rising as science learns to capture a constantly growing fraction of the available energy and turn it more effectively to useful ends. Every human being can be made at least 20,000 times as wealthy as he is today, but only fundamental investigations, such as atom smashing, will show how.

Almost every material problem of living turns out in the last analysis to be a problem of the control of energy. The householder, when he has paid his bills for fuel and electricity, is likely to consider that he has taken care of his energy requirements (*Concluded on page 334*)

THE INSTITUTE GAZETTE

PREPARED IN COLLABORATION WITH THE TECHNOLOGY NEWS SERVICE

Under the Burgee

NO undergraduate activity at the Institute has ever aroused such wide interest as dinghy sailing on the Charles River Basin under the burgee of the M.I.T. Nautical Association. But enthusiasm for this fine recreation is not confined to students and members of the Faculty, for Alumni throughout the country are showing their pride in the achievements of the Institute's racing skippers, now the champions of intercollegiate racing.

The latest indication of alumni interest in sailing comes in an announcement from Alfred T. Glassett, '20, President of the Technology Club of New York, that members of the club have voted to award a permanent trophy to be known as the Technology Club of New York Sailing Trophy. This prize is the result of the enthusiasm of the New York Alumni over the natural-color moving pictures of sailing at Technology, recently shown at the club by Walter C. Wood, '17, Master of the Senior House and Sailing Master. The New York trophy will be awarded annually to the student who, having had no previous sailing experience, makes the greatest improvement during the year. The cup will be an incentive for beginners to complete their training and qualify as racing skippers, thus earning the right to compete for the trophy at the end of the school year.

Student sailing has aroused greater enthusiasm at the beginning of its third year than ever before. The membership in this fast growing sport stood at 467 at the start of the year and has climbed to 533 as this is written. An additional group of 320 novice students applied for training this spring, and most of them have completed their Shore School requirements and are now getting their training as helmsmen.

Besides the recently established New York alumni trophy, the students are now racing for the Vose Cup, awarded for undergraduate supremacy; the Charles Hayden Sailing Trophy, the prize of the consolation division; and the Earl P. Charlton Sailing Trophy, which is open to graduate students and staff.

In addition to the intercollegiate championships sailed on the Charles on April 23 and 24 with Technology in the role of defending champion, two other important sailing events with other colleges are the Boston Dinghy Club Trophy Regatta on May 1, open to all colleges in the United States and Canada, and the quadrangular meet on May 8 between Harvard, Dartmouth, Brown, and the Institute. Our skippers will also visit Brown University on May 7, when they meet eight college racing teams at the opening of Brown's remodeled yacht club. Later they will visit the University of New Hampshire and possibly the United States Naval Academy at Annapolis. This last meet depends upon completion of suitable arrangements for competition during the spring holidays.

Many of those who witnessed the beginning of nautical activities at the Institute thought that once the novelty of sailing had passed, the growth of the activity would settle down to a modest annual increase. This year's enthusiasm and the crowded classes in the voluntary Shore School courses show, however, that the rate of growth is steadily increasing rather than diminishing, and indications are that the warm days of this month will find some 800 students on the rolls of the Nautical Association.

Course Changes

CHANGES in the Institute's courses in electrochemistry and mining engineering, which will bring the advantages of the former to a larger number of students and broaden the scope of training in the field of discovery and utilization of mineral resources, have been authorized by the Executive Committee of the Corporation.

The Visiting Committee of the Department of Metallurgy recently reviewed the status of electrochemistry at the Institute and has made three recommendations concerning it. The Committee pointed out that the substance of a course in electrochemical engineering has been, and still is, an extremely valuable factor in the field of technology. However, in view of the low registration in the course and because of the expanding opportunities for the application of the methods of electrometallurgy and electrochemistry to both science and industry, the Visiting Committee urged that the advantages of training in these subjects be brought to a much larger circle of students. The Department of Metallurgy, therefore, will assume the responsibility for providing that all students in metallurgy are adequately trained in electrometallurgy, both electrothermic and electrolytic.

The Department of Chemical Engineering has been asked to undertake that part of the instruction and research in this field concerning substances other than the metals. With these plans in view the Executive Committee has authorized the discontinuance of the course in electrochemical engineering in June, 1940, after the present sophomores and juniors have completed the present curriculum.

Recent studies by the Visiting Committee on the Department of Mining Engineering have emphasized the trend in the mining industry to demand engineers with special training in physics, chemistry, and geology, as well as in economics and business administration. These studies also show that the mining schools in the great mineral states adequately fill the local demand for men trained in the practice of mining operations, whereas the specialized curricula of mining departments of eastern universities have become relatively less significant or have been discontinued entirely.

The Institute's Department of Mining has had a very distinguished history, both in the quality of the men who have been graduated from it and in its contributions to the development of mining enterprise all over the world, especially during the decades when the mineral resources were first being explored by modern methods, and great mining companies were in the process of formation. The changed circumstances of the present day, however, indicate that the best use of the Institute's facilities in training for the general field of the discovery, recovery, and processing of minerals calls for a change of emphasis and a broader approach. The Executive Committee has accordingly voted to discontinue the special curricula in mining in June, 1940. The Department of Metallurgy plans to pay special attention to the subject of ore dressing, and the Department of Geology expects soon to present to the Faculty a proposal for the extension of its work on mineral resources, placing special emphasis on the scientific phases of this important field.

In order that this change may be made without disturbing the plans of students already enrolled in the Mining Engineering Course, the present sophomores and juniors will be carried through to graduation in June, 1940, under the old schedule.

Summer Conferences

FIVE special study programs, designed mainly for professional workers, will be held at the Institute this summer under the auspices of the Committee on the Summer Session. They will treat spectroscopy, colloid chemistry, textile analysis, strength of materials, and ceramics. The programs will last, in general, from three to six weeks, during which time special courses or lectures will be given. In several programs facilities for research, either independent or supervised, will be available to qualified men for longer periods.

Research instruments developed in the Institute's textile laboratory are contributing importantly to a better understanding of textile fibers and their utilization. One of the latest of these, the constant-load rate inclined-plane tensile tester, is a significant link between chemistry and microscopy in studies of the fundamental structure of textile fibers. This instrument, on which Professor Edward R. Schwarz, '23, is testing a specimen, measures repeated stress or fatigue, a factor only recently considered in the textile industry. Thus it is possible to distinguish between the plastic and elastic properties of the material — information of interest to manufacturer and consumer, as anyone whose trousers bag at the knee will agree

Courses in practical spectroscopy, for example, including lectures and laboratory work on the analysis of materials and on the general application of the spectroscope and its auxiliary apparatus to the problems of science and industry, will be held from June 13 to July 23. The laboratory will be available for research from June 1 to August 1, and the sixth annual Spectroscopy Conference is scheduled for July 18, 19, and 20, at which qualified authorities will discuss the application of the spectroscope to biology, medicine, chemistry, metallurgy, mineralogy, and industrial and engineering problems. The program is under the direction of Professor George R. Harrison of the Department of Physics.

For the third year a special summer program in theoretical and applied colloid chemistry and colloid physics will be offered for five weeks, beginning June 13. This program will be under the direction of Professor Ernst A. Hauser of the Department of Chemical Engineering and will consist of lectures on fundamentals as well as on industrial applications, round-table conferences devoted primarily to recent advances in the field and to current research, and laboratory investigations of special problems. Guest speakers from various industries, as well as outstanding experts in the field who will be in Cambridge to attend the 15th National Colloid Symposium at the Institute on June 9, 10, and 11, will be among the lecturers.

The summer session in principles of textile analysis will be held for six weeks, beginning July 25, under the direction of Professor Edward R. Schwarz, '23, of the Department of Mechanical Engineering. The work will include lectures and demonstrations, illustrated by experiments and moving pictures, together with laboratory exercises in the physical and optical analysis of textiles, textile microscopy, and fabric structure.

The program on the strength of materials, to be held from June 13 to July 8, will be divided into three sections — timber, concrete, and general strength problems — with lectures in each field, as well as comprehensive laboratory investigations. There will also be two seminars devoted to recent developments in the fields of structure of metals and structural stress analysis, and two all-day conferences, July 7 and 8, on timber and concrete, at which various aspects of these two subjects will be discussed by experts. The program will be directed by Professor John M. Lessells of the Department of Mechanical Engineering.

The fifth special program, in ceramics, will be divided into two sections, the first dealing with the nature of glass, to be held from July 11 to July 16, and the second with the reactions in ceramic materials on heating, to be held from July 18 to July 23. Laboratory experiments designed primarily to familiarize the student with modern apparatus will be included. Professor Frederick H. Norton, '18, of the Department of Metallurgy is in charge of the program.

Alumni Day at Technology

Commemorating on June 6 the Final Departure of the Institute from the Rogers Building

THE PROGRAM

June 6, 1938

Notice to Alumni: When you receive your final notice and application form this month, please return it promptly. Both the luncheon and the banquet last year drew unexpectedly large attendances, and this year the committee wishes, by adequate advance information, to be prepared to care for those who apply early.

Morning

8:30 A.M.–10 A.M. REGISTRATION in the main lobby of the Rogers Building, 491 Boylston Street

8:30 A.M.–12:30 P.M. RETROSPECTIVE EXHIBITION of work in the School of Architecture, Main Exhibition Room, Rogers Building

10 A.M.–12:15 P.M. SYMPOSIUM, Huntington Hall, Rogers Building

The Impact of Science on the Arts

Speakers

WILLIAM EMERSON, *Dean of the School of Architecture*, welcoming guests to Rogers and introducing:

A. LAWRENCE KOCHER, '13, *Editor*, the *Architectural Record*, presiding

WALDEMAR B. KAEMPFFERT, *Science Editor*, the New York *Times*
Title: "Science and Society"

JOHN MILLS, '09, *Director of Publicity, Bell Telephone Laboratories, Inc.*
Title: "Engineering and Art"

MALCOLM COWLEY, *Literary Editor*, the *New Republic*
Title: "Science and Letters"

FREDERICK KIESLER, *Director of Laboratory for Design Correlation, Columbia University*
Title: "Biotechnics and Architecture"

12:15 P.M.–12:40 P.M. FAREWELL TO ROGERS, Huntington Hall. Address by Charles-Edward A. Winslow, '98

12:40 P.M.–1 P.M. Transfer of activities to M.I.T. in Cambridge. Bus service from the Rogers Building to Cambridge will be provided

Afternoon

1 P.M.–2 P.M. LUNCHEON in Du Pont Court, M.I.T., Cambridge

1 P.M.–5 P.M. EXHIBITIONS in the Main Lobby and adjacent areas:
(1) The growth of an industrial design
(2) Scientific forms
(3) Streamlining in fact and fancy
(4) Photographic exhibition under the auspices of The Technology Review

2 P.M.–4 P.M. JOINT CLASS DAY EXERCISES with the Class of 1938 in Lowell Court. Alumni speakers: For the Class of 1888, WILLIAM G. BESLER, *Chairman of the Board, Central Railroad of New Jersey;* for the Class of 1913, LAURENCE C. HART, *General Sales Manager, Johns-Manville Sales Corporation*

4 P.M.–4:15 P.M. Adjourn to the steps of the new Architecture Building on Massachusetts Avenue

4:15 P.M.–4:35 P.M. DEDICATION of the new home of the School of Architecture

4:45 P.M. DEDICATION of the new Davis R. Dewey Memorial Library in Room 5-330

Evening

6:30 P.M.–10:30 P.M. STEIN-ON-THE-TABLE DINNER at the Hotel Statler, Boston

Speakers

MARSHALL B. DALTON, '15, *Retiring President of the Alumni Association*

KARL T. COMPTON, *President, M.I.T.*

JOHN MULHOLLAND, *Authority on Magic*
Address and demonstration on "Science and Magic"

Program for the Ladies

IT is expected that the morning symposium, the buffet luncheon, the afternoon exhibition will all be fully as attractive to the ladies as to the gentlemen.

9 A.M.–1 P.M. Room 16 in the Rogers Building will be put at the disposal of the ladies, and for those who do not care to attend the events in Rogers, the Emma Rogers Room in Cambridge will be open from 9:30 on

3:45 P.M. Open House at the home of Mrs. Karl T. Compton

4:45 P.M. Busses leave Mrs. Compton's for a short sightseeing trip through Cambridge on the way to The Country Club, Brookline

6 P.M. Dinner, The Country Club, Brookline

7:30 P.M. Return by bus to the Statler Hotel to participate in the evening's entertainment there

Note that the morning program is in the Rogers Building, 491 Boylston Street, Boston. Go there to register. One final word: The Banquet is not to be missed. It's to be a new departure in Technology festivals and it's included in the blanket ticket costing only $5.00.

You are invited and urged to join other Technology Alumni in this stimulating and entertaining program ". . . for it's always fair weather when good fellows get together . . ."

Executive Fellowships

THE Alfred P. Sloan Foundation of New York has made a grant of $15,000 to establish at the Institute five graduate, competitive fellowships for young industrial executives. These fellowships will cover 12 months of study in the Departments of Business and Engineering Administration and Economics and Social Science in a program of education for industrial leadership which expands the concept of managerial functions to include not only executive skill but social responsibility. The grant has been made by the Sloan Foundation as one phase of its endeavor to promote "the increase and diffusion of economic knowledge," namely, through the education of leaders.

Candidates for the fellowships must be between 25 and 35 years of age and must have had at least five years industrial and executive experience of a quality which merits leave of absence by their present employers. They must also have been graduated with high academic standing in science or engineering from a college or university of recognized standing. The fellowship stipends range up to $1,750 for single men and $2,750 for married ones. Applications closed April 25, and the awards will be made after a careful study of the qualifications of each candidate and consultation with his employer. Recipients will begin their work in June.

The program of advanced study is designed as a specific preparation for ultimate positions of higher administrative responsibility. The course, which covers a summer and a full academic year, will begin with a study of the fundamental elements of industrial activity, including principles of economics, production, marketing, finance, accounting, law, and labor. Emphasis will be placed on the responsibilities of the executive to society and on external influences bearing on industrial administration, such as international economics, labor legislation, governmental relationships to industry, comparative political institutions, and sociological developments. During part of their program the fellows will be given an opportunity to concentrate in a chosen sector of industrial activity, such as distribution, finance, production, or labor relations. Special investigations will be required to increase capacity for creative work. The course also provides for conferences and social contacts with 30 leading American industrialists, government officials, and labor leaders. Development of work and life habits consistent with administrative progress will also be considered.

The new fellowships constitute the second group in business administration and economics sponsored at the Institute by the Sloan Foundation. The first five fellows complete their work next month.

Staff Promotions

THE work of many younger members of the Faculty, as well as the contributions of a number who are well known to several generations of undergraduates, is recognized in the annual staff promotions announced in April. Professor Walter C. Voss, '32, was appointed to take charge of the Course in Building Engineering and Construction, succeeding the late Ross F. Tucker, '92, with whom Professor Voss was closely associated until the former's death last December. Howard R. Bartlett, appointed acting head of the Department of English and History during Professor Pearson's leave of absence, was promoted to the rank of associate professor.

Four well-known members of the Faculty advanced to the rank of professor were James A. Beattie, '17, and Tenney L. Davis, '13, of the Department of Chemistry; Carle R. Hayward, '04, Metallurgy; and Carlton E. Tucker, '18, Electrical Engineering.

Those who were promoted to the rank of associate professor were Frederick J. Adams of the School of Architecture; Joseph C. Boyce and Robley D. Evans of the Department of Physics; Matthew R. Copithorne, Frederick G. Fassett, Jr., and Dean M. Fuller of the Department of English and History; Charles S. Draper, '26, and Heinrich Peters of the Course in Aeronautical Engineering; Harold E. Edgerton, '27, of the Department of Electrical Engineering; Edwin R. Gilliland, '33, of the Department of Chemical Engineering; Charles W. MacGregor and Carl L. Svenson, '19, of the Department of Mechanical Engineering; Eugene Mirabelli, '19, of the Department of Civil Engineering; John T. Rule, '21, of the Section of Drawing; and John W. Williams, Biology and Public Health.

New assistant professors are Archibald W. Adkins, '29, and Peter E. Kyle,'35, of the Department of Mechanical Engineering; Walter E. Albertson, '33, of the Department of Physics; Bernard S. Gould, '32, of the Department of Biology and Public Health; Douglas M. McGregor of the Department of Economics and Social Science; William T. Martin and George P. Wadsworth, '30, of the Department of Mathematics; Lawrence A. Monroe, '34, of the Department of Chemical Engineering; Donald W. Taylor, '34, of the Department of Civil Engineering; Chester M. Van Atta and Lester C. Van Atta, Physics.

Promoted to the rank of instructor were Ralph J. Bowley and Brandon G. Rightmire,'37, of the Department of Mechanical Engineering; Harold A. Fidler, '34, of the Department of Civil Engineering; and John D. Trimmer of the Course in Aeronautical Engineering.

Elected

WALTER G. WHITMAN, '17, Head of the Department of Chemical Engineering, and ten Institute juniors have been elected members of the Institute chapter of Tau Beta Pi, the national honorary engineering fraternity. The new student members are Woodson W. Baldwin, Jr., of Brookline, Mass.; Harold Chestnut of Schenectady, N.Y.; John R. Diver of Waukegan, Ill.; Roy C. Heacock of Uniontown, Ala.; Stuart Paige of Port Chester, N.Y.; George G. Poulsen of Readville, Mass.; Charles T. Ryder, Jr., of Colorado Springs, Colo.; Paul E. Sandorff of Niagara Falls, N.Y.; John C. Vyverberg, Jr., of Rochester, N.Y.; and William F. Wingard of Baltimore, Md.

Visiting Committee Reports

DEPARTMENTAL Visiting Committees are appointed by the Corporation and in general are composed of two members nominated by the Alumni

Council, three from the membership of the Corporation itself, and two selected at large. Twenty-two of these Committees, with a combined membership of 154, are now actively serving the Institute by placing at the disposal of the departments their wide experience, their objective judgment of the departments' work and plans, and their strong support in helping the departments to gain approved objectives.

The reports of these Committees are published in condensed form from time to time in these pages and provide not only interesting comment on the Institute's educational work but convincing evidence as well of the help which these Committees are rendering.

This month we present reports on the Department of English and History and the Department of Military Science and Tactics.

MILITARY SCIENCE AND TACTICS*

COLONEL THOMAS-STAHLE, '22, Commandant of the Institute's military science unit, reviewed for the Committee the current situation of the military training plan at Technology, both in regard to the required training for the freshmen and sophomores, which is known as the basic course, and the advanced voluntary courses of the Reserve Officers' Training Corps, which lead to commissions as second lieutenants in the Officers' Reserve Corps upon graduation from the Institute. This advanced training is divided among five services: Signal Corps, Corps of Engineers, Ordnance, Coast Artillery Corps, and Chemical Warfare Service.

The first question to be discussed in detail was the maintenance at the Institute of an R.O.T.C. The Committee expressed its wholehearted belief in, and its support of, this advanced training. Viewed solely from the student and general Institute viewpoint, without consideration of any obvious national obligation, the Committee was of the unanimous opinion that R.O.T.C. units were of distinct advantage, and should be supported and encouraged. Formerly funds were allotted by the Federal government to permit the units at the Institute to train, in the advanced course, 300 students, half of whom would be juniors and half, seniors. However, due to the extension of R.O.T.C. units in other colleges throughout the country, without the corresponding increase in funds, the R.O.T.C. unit at the Institute is now limited to just over 200 students. The Committee considers this a most unfortunate situation.

Whereas in some of the colleges the full quota is not taken up and in others nearly all applicants who desire to take the advanced course are accepted, here at the Institute there are regularly between two and three applicants for every position. Because of the necessary rejections due to the limited size of the unit, many excellent men are lost to the service. Special attention should be directed to the fact that all of the R.O.T.C. units at Technology are technical and, accordingly, represent the most difficult type of officer training in a national emergency. Reference is further made to the very large number of Technology men who rendered military service in the grade of officer during the World War, and attention is directed to the high scholastic standards maintained at the Institute, making available the very best type of applicant for positions in the Officers' Reserve Corps. The Committee is of the unanimous opinion that this is a sufficiently important national situation to be brought to the attention of the proper military authorities and recommends that the Executive Committee of the Corporation empower President Compton to endorse a request from Colonel Thomas-Stahle that the R.O.T.C. advanced course at the Institute again be permitted to enroll 300 students.

Colonel Thomas-Stahle reviewed the changes that had been made in the curriculum to lighten the load on the students taking the advanced R.O.T.C. courses. The basic 20 unit-hour requirements have been reduced to 12 unit-hours in all except the Coast Artillery, which is now 16 unit-hours. This has been accomplished either by having regular Institute technical courses accepted by the War Department, or having such courses as Military History and Policy of the United States taught by the Institute (see page 322) and allowing the credits to apply against General Studies as well as against the hours called for on a military program. This situation seems well in hand, and no additional action is required by the Committee.

However, in connection with the course on military history, it is important that additional library facilities be obtained. This could be done either by the procuring of some additional books for the general library or by the acquiring of a library now in Boston. The proper housing at the Institute of this library and the actual obtaining of it, together with its endowment funds, represents a rather difficult problem, but it is one that should receive the earnest attention of the Institute and of this Committee. Aid in this direction is being obtained through the chairman of the Friends of the Library.

The Committee expressed considerable interest in, and its wholehearted approval of, the work being done by Colonel Thomas-Stahle in creating general interest

Christian Science Monitor

DOME NO. 2

. . . takes shape as the new building, to be named and dedicated on Alumni Day, June 6, rises on Massachusetts Avenue

* Members of this Committee for 1937–1938 are: H. B. Richmond, '14, Chairman, William E. R. Covell, '23, the late Brigadier General Alston Hamilton, Colonel Clifton C. Carter, '09, John J. Pelley, and Captain Walter L. Medding, '17.

in the basic military training course. The improvement of the lectures, the increase in drill in place of some of the lectures, the establishment of a merit to be known as the Order of Military Merit, and the possibility of increasing rifle marksmanship are all constructive steps along these lines.

The Institute has, in recent years, been particularly fortunate in the very excellent personnel assigned to handle the military work. It has never been more fortunate than at present, and this Committee would feel negligent in closing its report if it did not include in its findings a statement of its gratitude to Colonel Thomas-Stahle and his staff for the very high *esprit de corps* that they have established in the military training course at the Institute.

ENGLISH AND HISTORY*

THE Committee reviewed the teaching of English and history at the Institute, and all were impressed with the inherent difficulty of emphasizing the value of, and necessity for, a fine command of English on students whose first interest is preparing for a scientific career.

In order to obviate the lamentable lack of preparedness in English evinced by some applicants who are otherwise eminently desirable, Professor Pearson suggested that such students should be admitted to Technology conditioned upon their taking a summer school course in English before entrance to the Institute. While it is realized that defects in the use of English, possibly lifelong, could not be entirely rectified in a course of five weeks' training, it was pointed out that this period could be made an occasion for impressing upon the students —and upon the schools which prepare them — the absolute necessity of their devotion to the acquisition of a proper command of our language in order to make a success of their courses at the Institute and of their professional careers later. The Committee voted unanimously to recommend that such a requirement be made.

The discussion next dealt with the possibility of inducing professors in other departments to take more interest in requiring better English on the part of their students. It was voted to recommend that this be brought to the attention of the Faculty Council, with the suggestion that a committee be appointed to consider ways and means for having this matter placed before the professors in other departments and kept before them. A recommendation on this subject was included in the report of the Visiting Committee in 1934; it is renewed now in full recognition of the fact that this has often been a matter for Faculty discussion and action. The further suggestion was made that professors in other departments should decline to receive badly worded theses or papers but should turn them back to be rewritten, and that students in the upper years who showed a consistent lack of proficiency should be referred to the English Department for special training if they wish to complete successfully their studies at the Institute.

* Members of this Committee for 1937–1938 are: W. Cameron Forbes, Chairman, William H. Bovey, '94, Roswell G. Ham, George P. Dike, '99, Albert H. Wiggin, Arthur M. Schlesinger, and J. Rhyne Killian, Jr., '26.

Professor Pearson then brought before the Committee the possibility that the instruction in the subject known as Military History and Policy of the United States, hitherto given by the Department of Military Science and Tactics and required of those students seeking Reserve Officers' Training Corps commissions, might be put in charge of the Department of English and History (see page 321). He said his Department could take over this work with the increase of his staff by only one-half of the time of one person. The Committee recommends to the Corporation that it give favorable consideration to this suggestion.

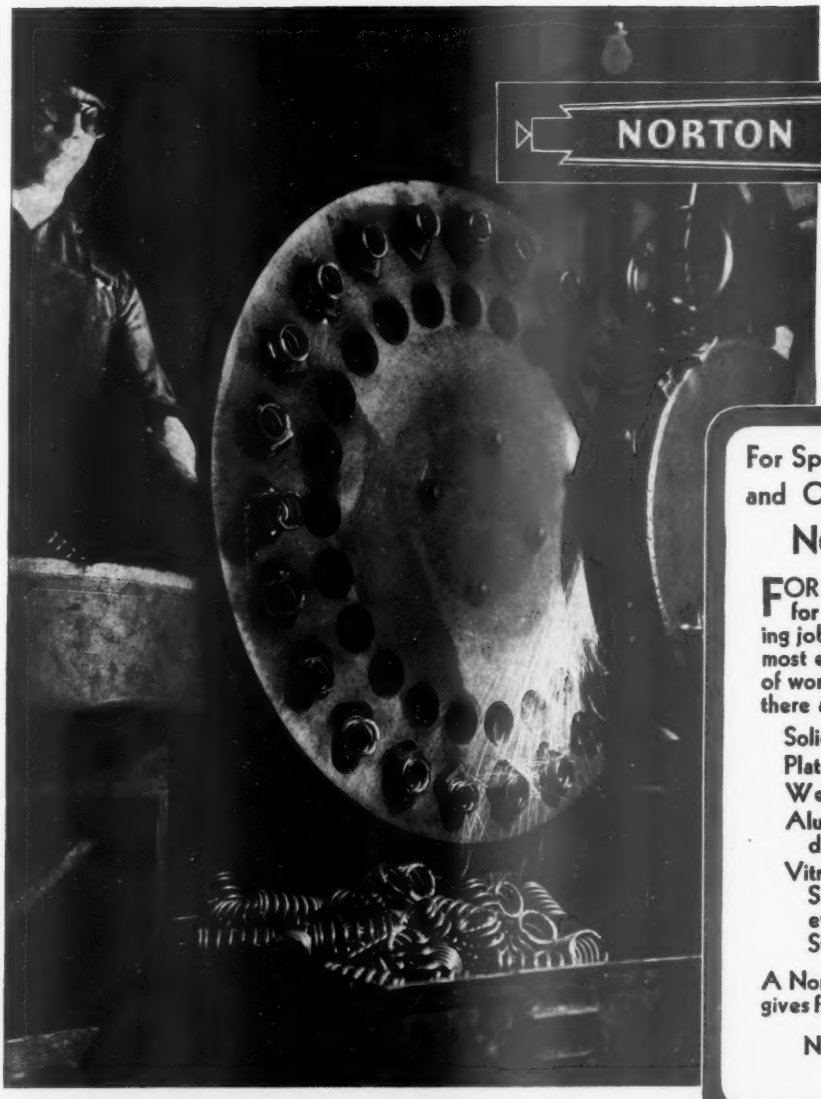
The Committee was pleased to learn that the subject of public speaking had been restored to the Institute curriculum as a General Study, as it believes that training in oral expression will prove helpful to young men in all walks of life.

Combination for Simplicity

AN astrophysicist employing a naval architect's methods works at a task of expert draftsmanship under the remote-control direction of a chemist and a mechanical engineer 400 miles away, to provide more efficient means of answering the mechanical engineering problems of turbine design. Result of this characteristic mingling of modern scientific disciplines is a blueprint chart, 30 inches wide and 15 feet long, containing a maze of cross lines and beautifully drawn sweeping curves. This, an enthalpy-entropy chart based on the "Thermodynamic Properties of Steam," published last year by Professors Joseph H. Keenan, '22, and Frederick G. Keyes, mechanical engineer and chemist, respectively, of the Institute, was executed under their supervision by Dr. Carol Anger Rieke. Pressures are plotted against temperatures on the chart, which is for use in the design of big turbines exhausting to subatmospheric pressures. The chart incorporates the data from the Keenan-Keyes steam tables and avoids the necessity of interpolation to determine a desired figure.

The master copy of the chart is in the possession of the General Electric Company, acting as custodian for the sponsors of the project, who included, in addition to the General Electric, the Allis-Chalmers Manufacturing Company and the Westinghouse Electric and Manufacturing Company. After the data from the tables had been plotted, the delicate task of laying off the long, sweeping curves was carried out by Dr. Rieke, who used the naval draftsman's splines — long, flexible strips of wood or celluloid — to produce lines of remarkable smoothness and uniformity. The work occupied time in the last year and a half, during most of which Dr. Rieke was at Johns Hopkins University in Baltimore, where, through the coöperation of Professor A. G. Christie, accommodations for the project were made available. Professors Keenan and Keyes then conducted their supervision by remote control.

A theoretical steam-rate table of 60,000 entries — more than in the steam tables on which it is based — answers the question of how much steam must be put through a perfect turbine to secure one kilowatt-hour from it. The American Society of Mechanical Engineers is publishing this table at the request of the sponsors.



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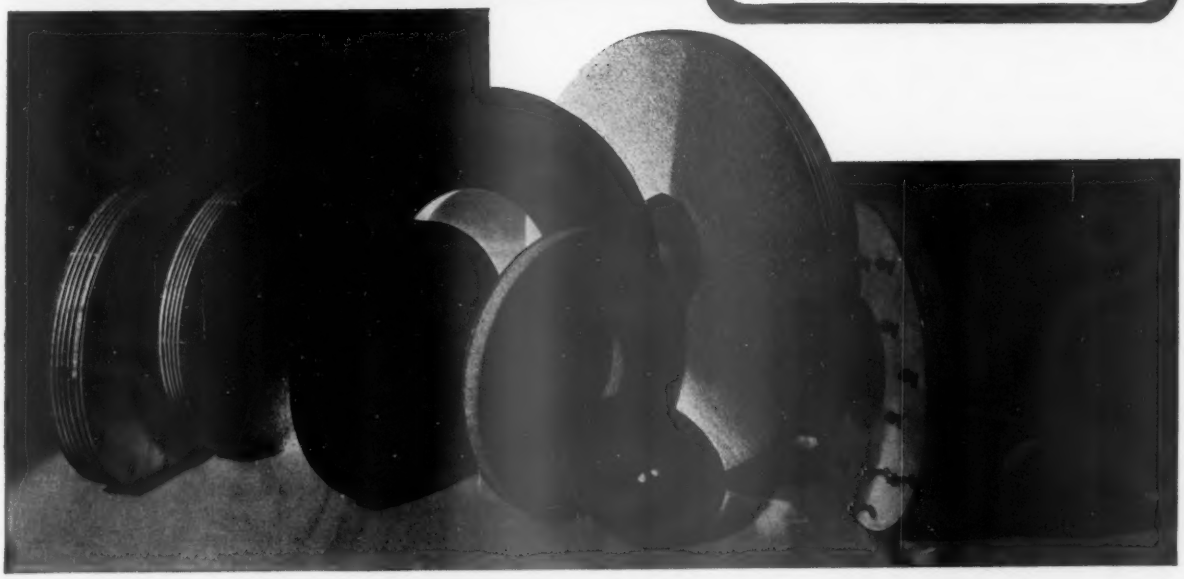

THE NEW ATTACK ON EVEREST

(*Continued from page 308*)

Nearly ten years elapsed between this ill-fated expedition and the one led by Hugh Ruttledge in 1933. This 1933 Expedition seems to have satisfied most Everest authorities on a number of points. First they are convinced that Mallory was wrong in trying the ridge and that the Second Step is unclimbable. This has forced a new detour which carries the climber below the steps on a long traverse ending in a *couloir* which reaches toward the summit. Aside from the danger of rockfalls, many mountaineers favor snow-filled *couloirs* as natural avenues to the top of a mountain. But this *couloir*, which has been reached by two sets of climbers, seems to have unusually difficult snow. The conclusion is that it, too, must be avoided and that the ascent must be made along its farther wall. It is evident that the original theory that "Everest is not a technically difficult mountain" must be revised. It is even possible that the entire plan of the campaign is at fault. Those who feel certain that this is a stupid comment might do well to remember the many futile attacks on the Matterhorn, all via the Tête de Lion, until Whymper made his accidental discoveries about the east face which had hitherto been regarded as sheer and unclimbable but which turned out to be almost a natural staircase. Whatever may be the easiest route on Everest, it is pretty clear that parties for some time to come will continue the approach via the Mallory route as far as the northeast shoulder and that thereafter they will abandon his ridge and, traversing, seek the summit by what is called the Norton Route or may even seek a lower traverse in accordance with suggestions by Smythe.

The 1924 Expedition had indicated the wonderful possibilities of slow acclimatization in the case of Odell. The 1933 party showed what can be done with scientifically planned diet, although the food failed to titillate the palates of the men who went high. Oxygen was set in its place by this group as an excellent shot in the arm but not as a steady ration. This party also introduced wireless telegraphic communication between the base camp and the upper camps and with Calcutta as well. Communication with the base camp sometimes broke down in critical moments, but that with Calcutta was useful and gave warning of breaks in the weather. Moreover, this group set a final camp at 27,400 feet. The 1936 Expedition met an over-early monsoon and failed to establish contact with the mountain at all.

What of the prospects for 1938? Like every previous party this one is well manned. It has learned more about food and clothes and temperaments. Its leader, Tilman, has already proved his distinction on Nanda Devi in 1936. In Odell, though no longer a young man, it has an experienced Himalayan, probably the best Himalayan climber still living. His exploits in 1924 in support of Mallory would give him that place alone, but they would be confirmed by his ascent of Nanda Devi in 1936. Tilman, Odell, Smythe, Shipton, Lloyd have all proved on previous Himalayan expeditions that they acclimatize well to high altitude, and the best evidence is that acclimatization carries over from one year to another to a rather remarkable degree.

In the last analysis, however, there are still many imponderables. The weather is the greatest. It alone can destroy an expedition. The climbing conditions on any great mountain vary from year to year and especially so on Everest. If the upper slabs are relatively free from snow, if there are no technical difficulties too great for man at 28,000 feet, if the monsoon comes slowly and the intermediate days are smiling days, then this may be the year. Hunch says it is. But logic remembers Mallory's probably conservative statement of the odds against success for any expedition being 50 to 1.

And what of it if they do succeed? The answer may not be important. If any significance exists, it is in man's demonstration of tenacity of purpose and willingness to sacrifice against heavy odds for the sake of an idea. Success on Everest is just as important as was the first ascent of the Matterhorn—so much and no more.

Mountaineers have ceased trying seriously to persuade lowlanders that science has much to gain from these expeditions. Every group still contains a scientist or two; a geologist, almost certainly; a botanist or naturalist, possibly; a meteorologist, perhaps. But when the final work begins, these scientists are of little value unless they are first of all mountaineers, and it is on the sum of their mountaineering ability and their probable tolerance — psychic and physical — to high altitude that they are chosen. Nor is there wonder that their scientific attainments fall into the discard.

No vegetation has been found on Everest much above 19,000 feet. The last 10,000 feet shelter neither flora nor fauna. These practically cease to exist a bare 300 feet above the traditional site of Camp I. No special rocks await the geologist's hammer at high altitudes. It has already been amply demonstrated by Odell in 1924 that it is possible for a human to go without oxygen and comfortably and more than once to heights of 27,000 feet. If physiological tests of man's capacities in rarified atmospheres are in question, they can be made under better controls in a London laboratory and at considerably less expense than the $50,000, or so, which a modern Everest party needs. Mapping and meteorological studies, as was demonstrated by the 1933 *Houston-Westland* expedition, can be carried on more successfully from the air. Though cold and windy, climatic conditions are no worse on Everest than those already dealt with by many a polar explorer. The conquest of this peak will add nothing to mountaineering knowledge; though difficult, the mountain apparently poses no climbing problem which has not been solved under less arduous circumstances in the Alps or the Caucasus. Even the view is not likely to entrance; views from topmost summits are, even under good conditions, not so fine as those from points of mid-elevation, while in the case of Everest the common testimony of those who have gone high is that mental lassitude obscures anything more than the mildest appreciation of the wonders set before the climber. If the assaults on Everest are the sublimation of mountaineering, they are equally clearly to the practical man the sublimation of nonsense. To the mountaineer, though, they are more. The sole purpose of climbing Everest is a mystic one — a religious one; if not a Christian one, it is nonetheless a sort of quest for a Grail. (*Concluded on page 326*)

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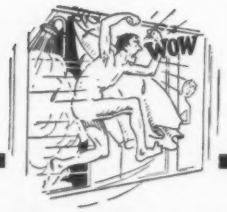

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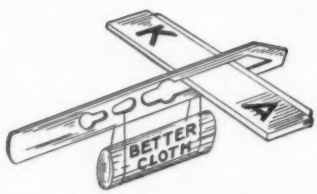

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THE NEW ATTACK ON EVEREST

(*Concluded from page 324*)

And when it is climbed? Of course little will have been proved. The men who do succeed will be no braver men, no better climbers, than those who have tried and failed. There will still be unclimbed peaks to surmount. And in a sense the world will have lost something — a tiny objective, perhaps, but possibly an important one for the spirit. Mountain climbers are modest folk, and the final tale of Everest will not be so thrilling as its predecessors. It is possible to portray at full scale the difficulties which overcome one but, as Tilman's account of the Nanda Devi expedition shows, it is not possible to write a ringing description of the difficulties which one overcomes. One is reduced to a laconic "we finished the climb by the ridge without further adventure, reaching the top at three o'clock."

So, too, must have been the final account of Parsifal when he returned to Monsalvat. The quest of an idea is more important than its attainment. However unscientific their objective may be, anticlimactic as may be its attainment, to Tilman and his gallant band The Review wishes all the possible favors of Nature during the month to come. They need no other.

MECHANICAL TESTS FOR DRIVERS

(*Continued from page 311*)

devices that draw continuous curves have the disadvantage of requiring much time for interpretation of results after the test is over. In order to save time in statistical analysis, we have so far avoided the use of recorders in favor of indicating instruments.

You will note that whereas there are 12 tests in the Harvard driver's clinic, there are only two pieces of equipment (Figures 1 and 2). Driver test apparatus is popular. It has to be moved around from place to place. This demands compactness and portability, also ability to stand hard knocks and to operate under all conditions. All of these factors and many more have been considered in the evolution of our equipment over a four-year period.

Assembling many tests to form a clinic permits us to find a weakness in everyone. Once a clinic supervisor pierces the armor of conceit of Mr. Average Driver, he can often get him to break down and talk about himself. Demonstrating a relevant sensory or motor defect will jolt the confidence of any individual and open the way to self-study and self-discovery.[8]

It is not, however, the result of any one test, even if the rating in it is low, which is most important; rather it is the composite picture of the results of all of the tests. The best way to demonstrate this is to refer to the sample profile graphs (Figures 3, 4, and 5). Figure 3 is the rare individual who is superior in most all tests. Figure 4 is an average individual — not typical because there are no two profiles alike. Profile graphs vary greatly from person to person. Some are predominantly average; some are a combination of chiefly superior and below average scores. The majority, however, like Figure 4, contain scores in all three (*Concluded on page 328*)

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MECHANICAL TESTS FOR DRIVERS

(*Concluded from page 326*)

ranges, indicating superiority in some abilities, average in others, and below average in others. Figure 5 is the unskillful person. The profile is therefore a diagnosis of the strengths and weaknesses in sensory and motor make-up, or skill.

The subject cannot, however, receive the maximum benefit from the battery of tests unless the diagnosis is put into the hands of a skillful clinical supervisor. The experienced clinician can, during an interview, interpret the test data. By courteous treatment and by genuinely interesting himself in the subject's welfare, the clinic supervisor can encourage him to talk freely about his accidents or near accidents. There is no better and more lasting teacher than self-discovery. The best supervisor is the one who, by his speech and demeanor, encourages mental and behavioral analysis. Autobiographical reminiscence about his driving is of great benefit to the subject when considered in the light of an objective clinical analysis of weaknesses.[1]

In summary, the mechanical tests developed by the clinic of the Harvard Bureau for Street Traffic Research have evolved by frequent redesign as a result of factors discussed. The assemblage of apparatus forming a clinic must be operated by a trained supervisor. He must be skilled not only in diagnosis but also in the treatment and care of drivers by their self-enlightenment and training. Just as in certain cases the doctor prescribes rest to let nature cure the patient, so the driver clinic supervisor may prescribe less speed and perhaps less driving until the ills disclosed by the clinic are cured or compensated for. Similarly, just as in certain cases the psychiatrist prescribes self-analysis and a direct attempt at overcoming faults, so the clinic supervisor may prescribe analysis by back-seat drivers and a training course to overcome defects. Or like the vocational counselor, the clinic supervisor may prescribe giving up automobile driving or at least avoiding making a living at it. Driver clinic apparatus interests drivers in themselves. It satisfies the human craving to find how one compares with the average person. It is found to be a great aid to a state driver-training program.[6]

[1] H. R. DeSilva and S. Abercrombie, "Clinical Treatment of Traffic Violators," *Police Journal*, Vol. 24, No. 2, pp. 3–7, December, 1937.

[2] W. H. Forbes, D. B. Dill, H. R. DeSilva, and F. M. VanDeventer, "The Influence of Moderate Carbon Monoxide Poisoning upon the Ability to Drive Automobiles," *The Journal of Industrial Hygiene and Toxicology*, Vol. 19, No. 10, pp. 598–603, December, 1937.

[3] H. R. DeSilva, "Facts About Automobile Drivers," *Harvard Alumni Bulletin*, Vol. 40, No. 14, pp. 448–451, January 21.

[4] H. R. DeSilva, "Human Element in Stopping a Car," *Brake Service*, Vol. 8, pp. 183–186, February.

[5] H. R. DeSilva, "Occasional Accident Operator," *Canadian Public Safety Journal*, April.

[6] H. R. DeSilva and P. Robinson, "The Driver Clinic in Delaware High Schools," *Safety Education*, pp. 174–178, March.

[7] H. R. DeSilva and T. W. Forbes, "Driver Testing Results," Monograph, Harvard Traffic Bureau, 1937.

[8] H. R. DeSilva, "Applications of Driver Clinics," *Safety Engineering*, April.

[9] H. R. DeSilva and R. Channell, "Driver Clinics in the Field," *Journal of Applied Psychology*, February.

[10] H. R. DeSilva, "A Bibliography on Driving Safety," *Harvard Bureau for Street Traffic*, p. 157, 1937.

SCIENCE AND CULTURE

(*Continued from page 314*)

Massachusetts Bay; the scientific age — in which the practical results of that discipline come home to everyone — is contemporary with such recent personages as Queen Victoria and Abraham Lincoln. Those results of applied science which constricted the world to internationalism and expanded industry to the factory — the telegraph and the steam engine — date back to late 18th Century experimenting. The consequence of abstract science which most upset the average man — the Darwinian hypothesis — is not yet nonagenarian. It is only within the last 100 or 150 years that, as Sir William Dampier puts it, "the whole conception of the natural Universe has been changed by the recognition that man, subject to the same physical laws and processes as the world around him, cannot be considered separately from the world, and that scientific methods of observation, deduction and experiment are applicable, not only to the original subject-matter of pure science, but to nearly all the many and varied fields of human thought and activity."

The play of science as a force in the complex of civilization, which in actuality has been under way since the time of Newton, reached only in the time of our grandfathers that powerful movement required to make it obvious to the generality. When the phase of recognition was reached, a delicate balance seemed in danger of being upset, the complex seemed in danger of disruption, and their very inertia stirred defenders of the *status quo* to belabor science, commencing thus too late an effort which must have been commenced centuries earlier to succeed.

A temptation to digress is presented by the basic inutility of such attacks and defenses as the mid-19th Century battle, not to speak of latter-day protestations about scientific holidays and truces to research. Argument pro and con may deflect into a certain channel but cannot stop the flow of a social force, once the intellect has released it. As well talk of this nation's "rejecting" capitalism, or of Russia's "adopting" communism. Doubtless, Huxley and his cohorts served to avert possible hindrances to scientific progress and so to permit the speedier development of science as part of the social ferment out of which the idea of culture is distilled. Any case beyond this, though, they need not have argued, for the inevitabilities were arguing it more cogently.

In part as a consequence of their vigor, however, the process of absorption has been so swift that in less than a half century, the second phase, that of appropriation, has been reached. That the conception of general culture is being revised because of the appropriation of scientific materials and techniques can hardly be doubted after even a hasty glance at contemporary indications. This is no place for a schoolmaster's harangue on the displacement of the classics from college curricula. That displacement may not be so very significant anyway. However, the rise of schools of university grade, professionally specialized in the sciences, is a different matter. So is the action of such an organization as the Associated Press, (*Continued on page 330*)

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SCIENCE AND CULTURE

(*Continued from page 328*)

when it sets up an editorial division devoted to science, partly as response to popular demand, partly as performance of the editorial responsibility of recording that which is important. So is the effort, however amateurish, of government to utilize objective method, whether through Democratic brain trusts or through Republican professorial program committees. The gradual appropriation by literature of more and more scientific data and allusions is another comparable effort. The assimilation of science into poetry — the phenomenon which may be considered final witness of the incorporation of a new force into a culture — is yet to come, of course, for it belongs rightly to the third, assimilative, phase; but it may be well on the way. Establishment of a Pontifical Academy of the Sciences represents about the most striking antithesis of the cause of the greatest tumult in our grandfathers' day — the warfare, so called, of religion and science. This, the greatest clash of the phase of recognition, has been well composed; in our day, during the appropriative stage, it is replaced by economic warfare, stemming from appropriations of science which are premature, in that they lack the guidance to be expected after assimilation is complete.

On a more immediately substantial plane, the fact that the government of the United States can carry on a public campaign against syphilis, thus invading privacies hitherto sacrosanct for dozens of reasons, is symptomatic of a degree of social objectivity never before realized. A gradually increasing objectivity about the question of birth control is similarly indicative. That these two symptoms have to do with matters of sex is not altogether fortuitous, as may later appear. They are allied by the general mind in one way with yet a third — the utilization of every means made available by science for the care and preservation of individuals ill fitted for survival, if judged on a coldly objective basis.

If we choose to regard these and other similar phenomena as symptomatic of a breakdown of conventions in themselves desirable, we may incline to agree with the opponents of science in the general proposition that science menaces human traditions necessary to the good life. It is easy, looking at technological unemployment or at modern civilized war, noting the mounting record of divorce, calculating the current crime bill, listening to the flapdoodle of the radiorator — it is easy to say, "So this is what science has done to our culture! Out upon it!"

SUCH easy acquiescence in this conclusion can occur only if the full import of our theory is not squarely reckoned with. Dismay over some evidences of the appropriative phase in the absorption of science into our culture echoes the dismay that attended the phase of recognition. That dismay results from failure to realize that the process is not yet complete, from failure to consider the outcomes of the third phase, assimilation.

These premature fears grow out of concern for sympathy as a constituent of individual culture. None but the most stubborn traditionalist will disagree that sci-

ence, far from limiting the perceptive range of the intellect, has left intact all the stores of meaning which man originally possessed as instruments for the cultivation of his appreciative power and has added to them vast new stocks. So far as two of the elements of individual culture are concerned, then, we are better off because of the rise of science as a social force.

Many aspects of the appropriation of science, however, are beyond doubt repugnant to the sympathetic aspect of individual culture. The objective method, as far as it is impersonal and searching, flies in the face of many preconceptions about humanity when this method is brought to bear on human problems, as it is so frequently. The kind of mind which is swayed by incomplete and partial propaganda from antivivisectionists readily translates the photographed rat into a "soaring human boy" whose traditional wings are to be clipped, if not by the pediatrician then by the vocational director to whom he is a mere numeral possessing certain aptitudes and certain defects. Mass movements of population at governmental behest; abolition of associations set up through centuries; ticketing, docketing, and cataloguing of individuals in Social Security or in unemployment categories — these are but a few of the infringements of accustomed personal liberty which may be cited. Innate respect for human rights, one may conclude, suffers horribly from the practice of objective method; practitioner and subject alike are mechanized. The philosophy of "live and let live" which is thus outraged has been for so many years such a convenient means of winking at social injustice and abuse that reluctance to abandon or revise it is natural. And during the appropriative phase, application of objective method to social questions has, it is true, suffered often and will for some time continue to suffer from the fact that both practitioner and subject lack perspective and see only in terms of immediate application rather than long-term motive or purpose. Proper perspective has so far been acquired by practitioner and subject in only one aspect of science, the one aspect which may be said to have reached the stage of assimilation. That is medicine. When a similar appreciation of motive or purpose has been attained in other fields by practitioner and subject, each will be brought nearer to the other's status, nearer to reciprocal sympathy.

Sympathy, as realized and expressed in the older terminology, is not powerful enough at the present to deal with the new force. It is, indeed, not too much to say that those social institutions whose business it has been to develop the quality of sympathy in the concept of individual culture had fallen short of their task even before the age of science opened. Notable is the fact that it remained for science, while still in the appropriative stage, to attack the medieval squalor of the modern slum, which had gone not unquestioned but untouched through earlier decades. The inadequacy of sympathy in the older definition is evidenced by its degeneration into sentimentalism in several vitally important spheres, unfortunately in exactly those spheres where science now is being most extensively appropriated. The obscurantism which has kept venereal disease spreading is the practical aspect of sentimentalism, which links opposition to (*Concluded on page 332*)

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SCIENCE AND CULTURE

(*Concluded from page 331*)

birth control, the often cruel prolongation of human life, and a sense of outraged horror at the Parran campaign. To sentimentalism — the perversion of the older sympathy — must likewise be attributed the toleration of economic injustice, inexplicable on sincerely religious or philosophical grounds; whether this toleration can continue in face of the pragmatic attack of objective method, or whether humanitarianism will find a strong ally in what it has thought to be a foe, remains to be seen.

This is not to say that a corresponding perversion of sympathy is not latent in science. If the older definition had its Dickens, the newer already has its Hemingway, with what else to come we do not speculate. The all but sadistic self-abnegation of some scientists who, prone before the atom, profess to abandon free will, relinquish the soul, and become one with the worm (and a dead worm at that) finds its parallel in Jonathan Edwards. Truly, the perversion of sympathy is the prerogative of neither the old nor the likely new definition of individual culture.

Probabilities, however, favor in the redefinition that will follow the final assimilation of science a quality of sympathy elevated beyond that of the present, preserving the imponderable and desirable things which we now class under the term, but adding to them and illuminating some among them which we now accept without full understanding. The arbitrary discriminations of Calvinistic predestination, for example, are impossible when sympathy has been clarified by the admixture of science. The dignity of life becomes the greater as we learn more of its intricate complexity. And the arrogance of the scholastic becomes impossible before the impenetrability of a final mystery which, when touched, dissolves into yet greater mysteries. If humility is an element of sympathy, the gradual dissemination of the scientific attitude of mind into the concept of individual culture is one of man's chief avenues to sympathy. Lastly, the sense of fundamental unity which is bred of science is warranty that such perversions as are illustrated by Vittorio cannot extend into the day when the final assimilation of science into culture has been accomplished.

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(*Concluded from page 316*)

for the month, but every bill from the grocer or the milliner is quite as truly a bill for energy. We do not buy a basket of strawberries for the carbon, oxygen, and nitrogen atoms they contain but for the energy stored by these atoms when they join together in molecules to form sugars, starches, flavors, and vitamins. That part of the cost of a lady's hat that does not represent business acumen on the part of the milliner is for stored and directed energy. The matter of which the hat is composed is permanent, and the atoms which composed it will still exist when the hat has been discarded and burned. Only energy and the knowledge of how to apply it are needed to recreate a hat from its smoke and ashes!

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It is not always necessary to wait a generation to see the practical results of new discoveries in physics. The tempo of discovery and invention is speeding up, for as more new forms of matter and energy are added to those we already control, the chance of several of them fitting together to form a useful device increases. New atomic rays discovered during one year are a year later being applied to the treatment of disease. In fact, as this is written, medical men are waiting for new rays having greater penetrating power than any yet produced; physicists are calculating how to produce them; the necessary apparatus is being assembled; and the waiting patients should shortly find available rays which are as yet unknown but on which for them so much depends.

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General Electric scientists and engineers, by developing electric machinery, have put into the hands of American workmen the greatest force ever devised for producing more goods for more people at less cost—the force of electricity.

G-E research and engineering have saved the public from ten to one hundred dollars for every dollar they have earned for General Electric

GENERAL ELECTRIC

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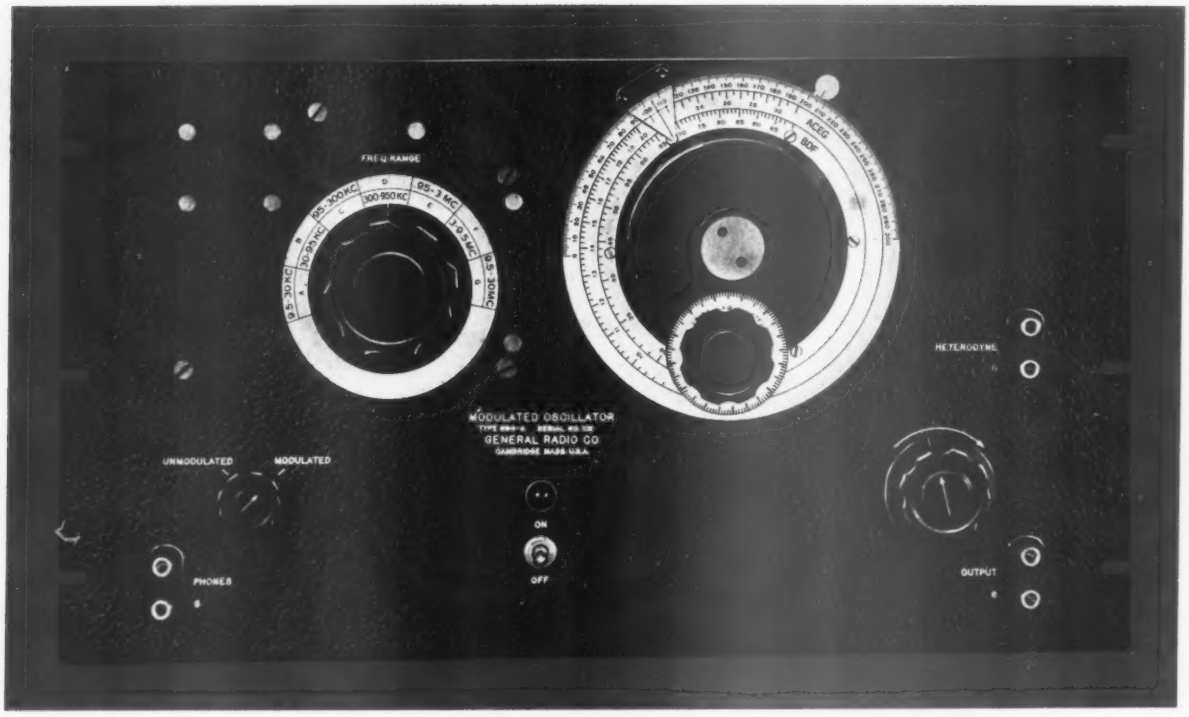
1938—OUR SIXTIETH YEAR OF ELECTRICAL PROGRESS—1938



NEW MODULATED OSCILLATOR

THIS new G-R general-purpose modulated r-f oscillator fills a long standing need for a source of r-f power covering the major portion of the useful radio spectrum, with good output and excellent frequency stability. Its advanced electrical and mechanical design includes a number of features which combine to make it an extremely useful laboratory driver with many operating conveniences.

CHECK THESE FEATURES

1. **WIDE FREQUENCY RANGE** — 9.5 kc to 50 Mc. *Direct reading* to 30 Mc; calibration chart 30 to 50 Mc.
2. **OPEN TUNING SCALE** — effective scale-length of *38 feet* between 9.5 kc and 30 Mc.
3. **IMPROVED TUNING CONDENSER** — cast aluminum one-piece frame — ball bearings — four spring contacts to rotor.
4. **EXCELLENT STABILITY** — frequency calibration good to 1% — good enough for approximate frequency measurements.
5. **HIGH OUTPUT VOLTAGE** — 25 volts at 100 kc; 30 volts at 1 Mc; 5 volts at 15 Mc; 1.5 volts at 30 Mc.
6. **BUILT-IN VOLTAGE REGULATOR** — regulated power supply insures constant output voltage over normal fluctuations in line voltage.
7. **OUTPUT AMPLIFIER** — isolates oscillator from output circuit — effects of modulation and load variations on frequency are negligible.
8. **1000-CYCLE INTERNAL MODULATION** — supplied by modulating oscillator — 1,000-cycle terminals on panel for a-f testing.
9. **BUILT-IN DETECTOR** — for obtaining heterodyne beats when oscillator is not modulated.

TYPE 684-A MODULATED OSCILLATOR — A-C Power Supply..... $340.00
Battery-Operated Model..... 320.00

• **WRITE FOR BULLETIN 265**

GENERAL RADIO COMPANY — CAMBRIDGE, MASS.

New York Los Angeles

PRECISION ELECTRICAL LABORATORY APPARATUS

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